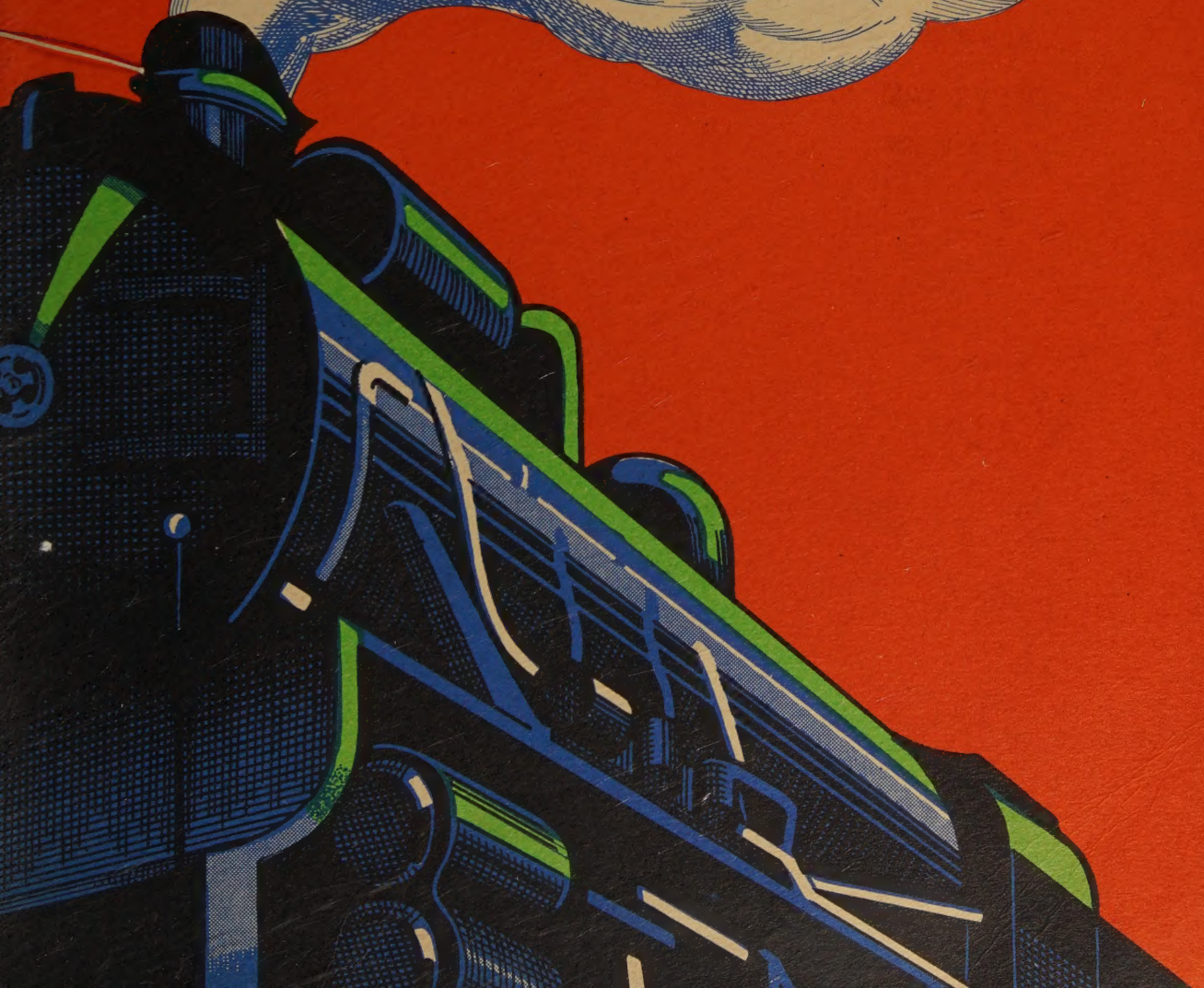
VOL. XXXV. — No. 4. APRIL 1958.

Monthly Bulletin of the International Railway Congress Association

(English Edition)



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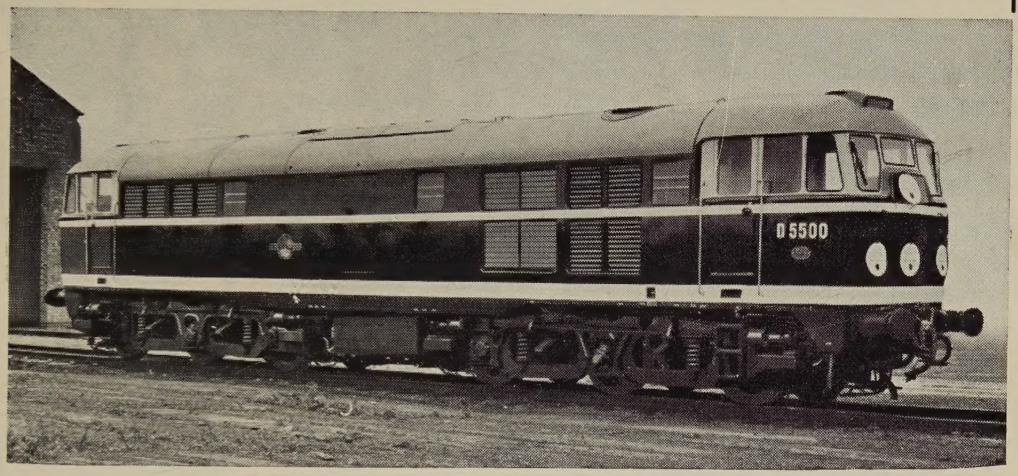

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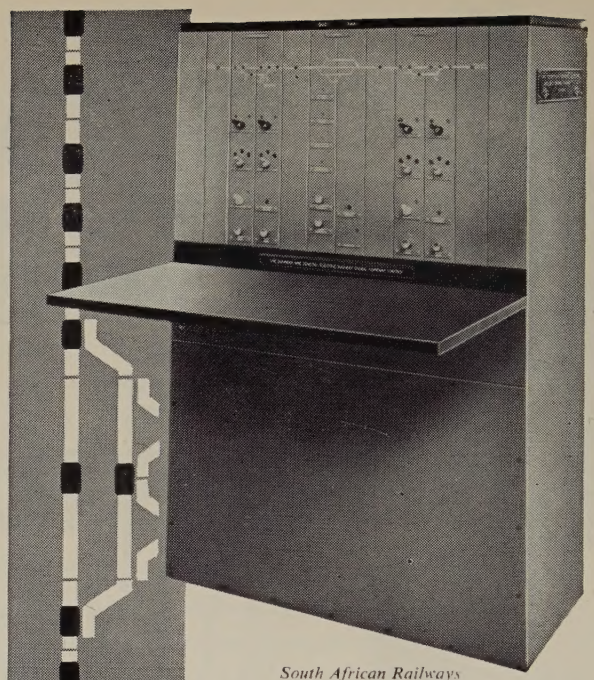

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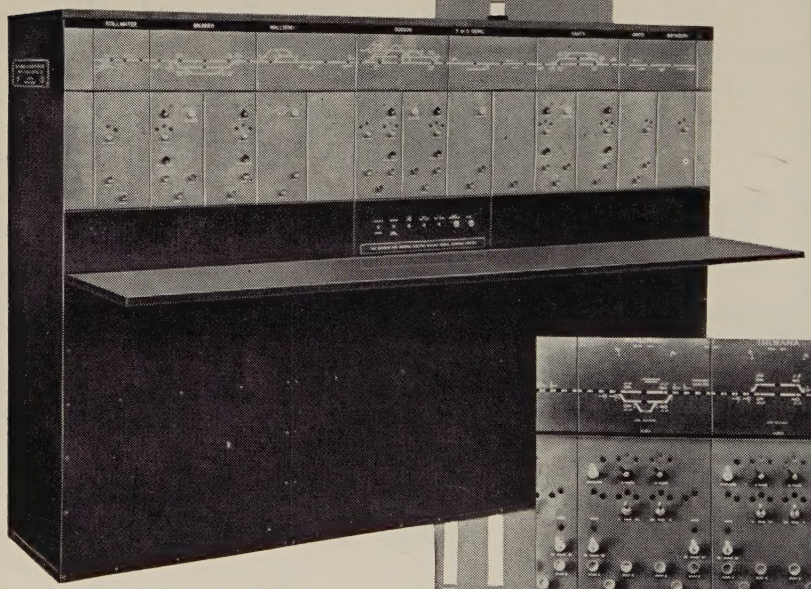

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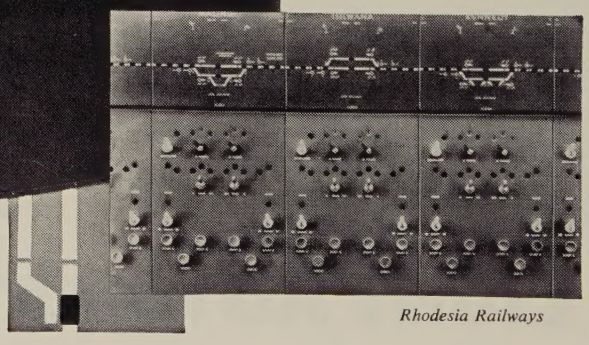

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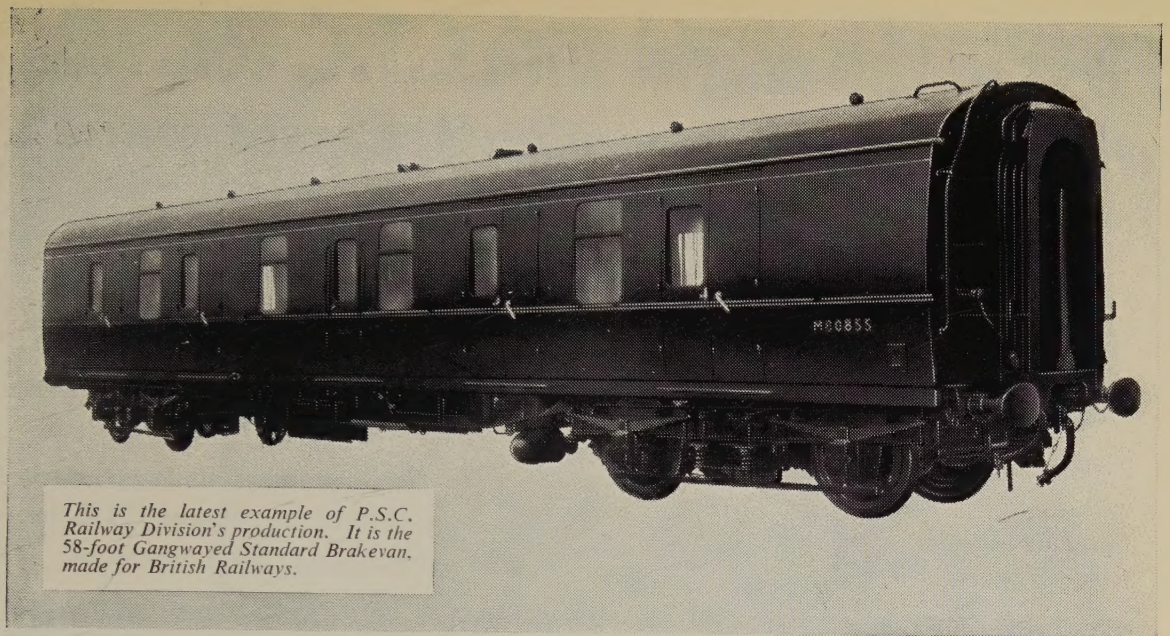

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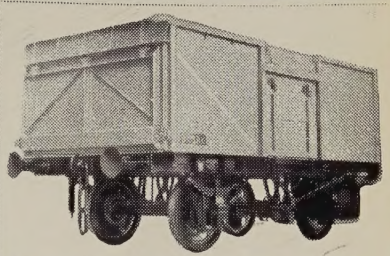

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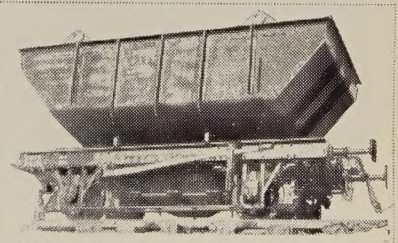
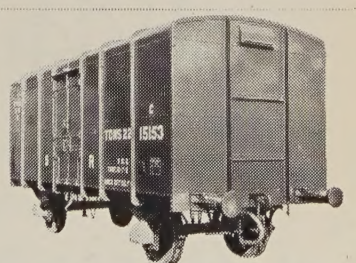


V.J.M. Hopper-type Wagon with drop bottom door for coal, as used by Queensland Government Railways, Australia.



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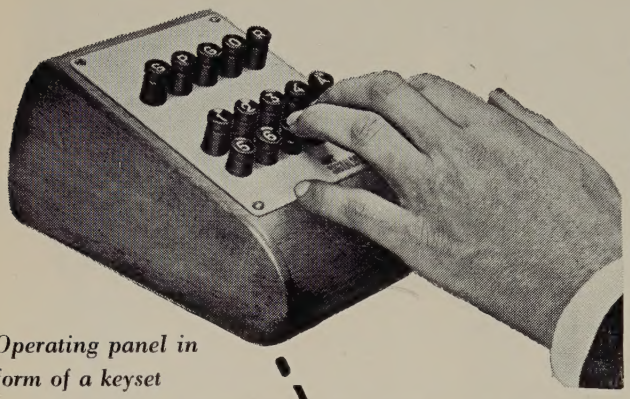

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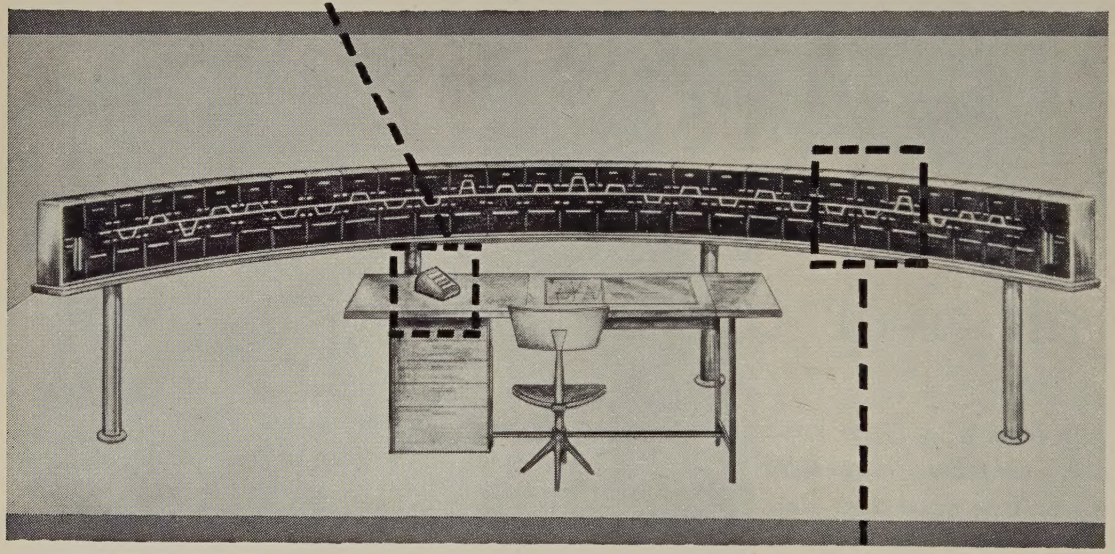

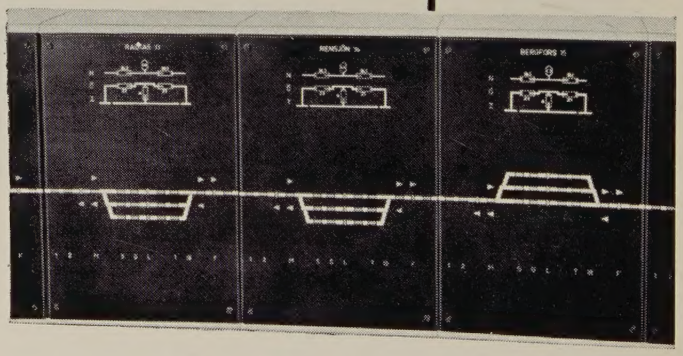

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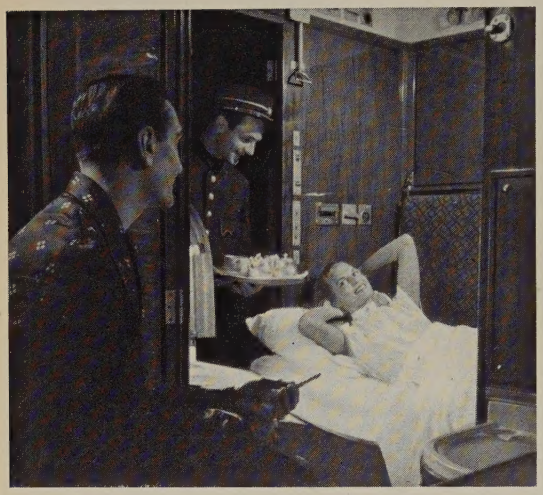

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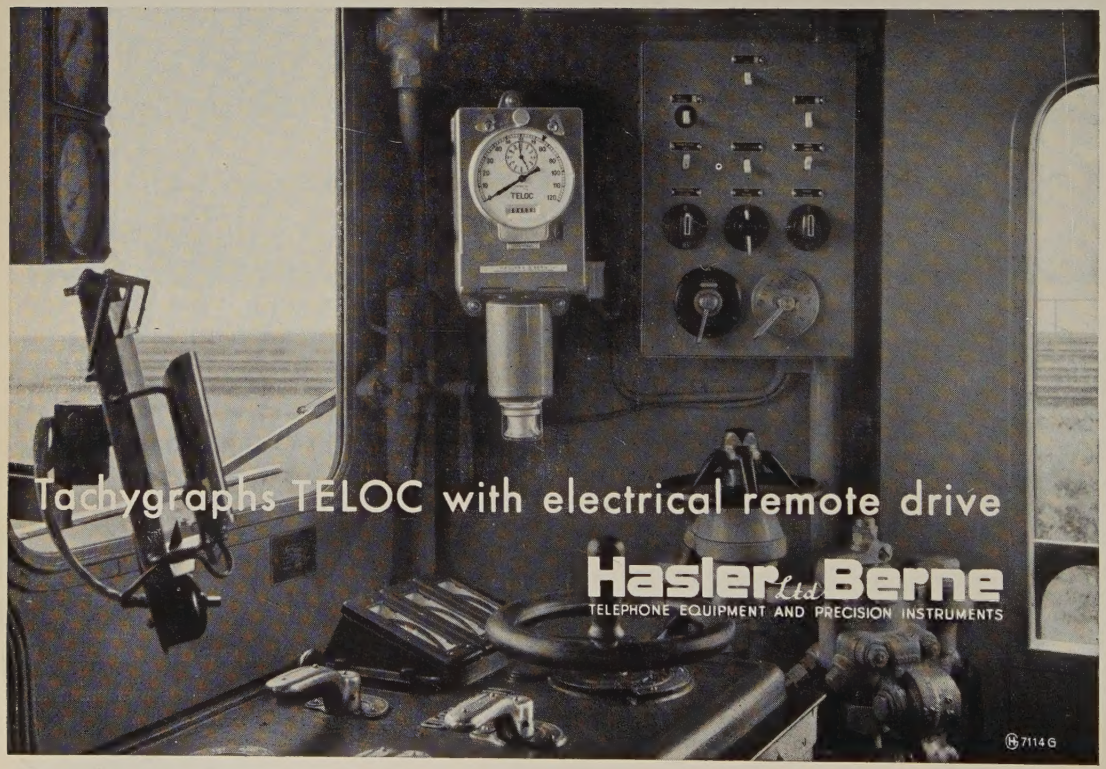
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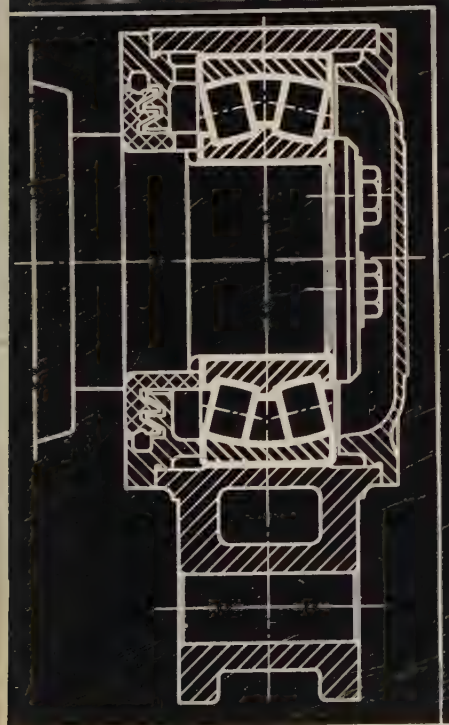

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MONTHLY BULLETIN

OF THE

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

(ENGLISH EDITION)

PUBLISHING and EDITORIAL OFFICES : 19, RUE DU BEAU-SITE, BRUSSELS

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Vol. XXXV. — No. 4. April 1958.

BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

[621 .3 : 651]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

17th. SESSION (MADRID, 1958).

QUESTION 7.

Advantage of the use of high speed electronic apparatus for certain administrative work such as :

1) the making out of pay slips;
2) traffic and stores accounts;
3) the checking of the movement of empty and loaded freight wagons, thereby improving the distribution of rolling stock;
4) compiling more rapidly already existing statistics, thus having also the possibility of preparing new ones.

REPORT

(America (North and South), Australia (Commonwealth of), Burma, Ceylon, Egypt, India, Iraq, Iran, Republic of Ireland, Japan, Malaysia, New Zealand, Norway, Pakistan, South Africa, Sudan, Sweden, Union of Soviet Socialist Republics and the United Kingdom of Great Britain and Northern Ireland and dependent overseas territories),

by Sten UBBE,
Chief Stores Manager, Swedish State Railways.

I.

To throw some light on question No. 7, a detailed questionnaire, compiled by the two reporters in consultation with the association's secretariat, has been sent out to various railway administrations in the following countries: United Kingdom of Great Britain and Northern Ireland, including the territories for whose international relations the United Kingdom is responsible, Union of Soviet Socialist Republics, United States of America, Burma, Egypt, India, Malaya, Pakistan, Iraq, Iran, Sudan, Japan, Argentina, Brazil, Australia, Ceylon, New Zealand, South Africa, Republic of Ireland, Norway, Sweden and Uruguay.

The intention was that the replies sent in by the administrations should give the reporters the possibility of judging how the relevant problems were regarded in the various countries and what was being done to solve them. Above all, there was a desire to find out what had been or what was thought to be gained by employ-

ing electronic data processing machines for various purposes.

By electronic data processing machines, abbreviated to EDPM, we mean machines which are made up of electronic units operating at high speed and of high capacity and which can perform any calculation or logical operation (comparison) working from a stored programme.

Questionnaires in English, answers to which should have been addressed to me, have been sent to 27 different administrations and also to the Association of American Railroads. Those administrations that have not yet sent any replies to the questionnaire, presumably have nothing to report — either negative or positive — and for this reason, they have not been sent more than one reminder.

It should be said right at the start that this question — as far as an expected positively illustrative answer is concerned — appears to have been taken up for consideration at far too early a stage. The fact is that it is evident from the replies that have come in that the development is generally still in such an early phase (if the questions have been taken into consideration at all), that there is, as a rule, very little experience to relate.

Answers to the questionnaire have been sent in by 23 administrations. Of these, the following 13 have reported that they have not taken up the question of electronic data processing and have therefore *not considered themselves in a position to answer the questionnaire :*

1. Railways of Rio Grande Do Sul, Brazil;
2. East African Railways and Harbours;
3. Malayan Railway;
4. Railways of New South Wales;
5. Tasmania Railways;
6. New Zealand Government Railways;
7. Indian Railways;
8. Ceylon Government Railway;
9. Iraqi State Railways;
10. Coras Iompair Eireann, Eire;
11. Sudan Railways;
12. Grängesberg — Oxelösund Railways, Sweden;
13. Ferrocarriles del Estado, Uruguay.

The following remaining 10 administrations *have sent in more or less comprehensive answers to the questionnaire :*

1. London Transport;
2. Nigerian Railway;
3. South African Railways;
4. Rhodesia Railways;
5. Norwegian State Railways;
6. Egyptian Republic Railways;
7. British Transport Commission;
8. Japanese National Railways;
9. Swedish State Railways;
10. Association of American Railroads.

Five of these 10 more positive replies have in many instances included detailed and illustrative descriptions of work carried out with conventional punch-card machines. At the same time, however, they state that electronic data processing is not yet in question in the administration. Three administrations have given comprehensive answers to the questionnaire while the Association of American Railroads consider that the questionnaire is not applicable to the association as such, and that only those private railway companies and administrations belonging to the Association — which have not been directly approached — can provide the information requested.

Merely the proportionality 13 : 10 of negative and positive replies invites cautiousness when judging this question from a point of view of experience. It is evident even from the positive replies that, in many places, there is little known about data processing machines and their qualities and that it is impossible to state the advantages of data processing in the work of the railway administrative departments.

The material made available by the answers to the questionnaires for a significant report on the question as it has been formulated, is therefore, in reality, far too meagre for any general conclusions whatsoever to be drawn.

II.

To avoid unnecessary repetition on the question of the technical description of EDPM and their characteristic qualities, I would refer to the report written by Mr. de Fontgalland, to be found in this bulletin. This applies particularly to an account of the latest technical developments in in- and output media, central units, conditions of operation of the machines such as reliability and capacity, and conditions of utilization such as hire-purchase and machine service.

III.

The main fields of application which one generally endeavours to adapt to the EDP-system are those where a certain degree of mechanization has already been reached, preferably with the help of traditional punch-card machines. Figure 1 shows a table based on the answers sent in, of the most commonly occuring applications :

Applications	*Number of applications*
General accounting	4
Cost accounting	4
Stores accounting	6
Payroll	5
Pensions	2
Staff statistics	5
Traffic revenue accounting	3
Freight traffic statistics	4
Passenger traffic statistics	4
Mileage	5
Wagon interchange with foreign Administrations	2

Fig. 1.

There is far too little material available to be able to state with sufficient certainty the fields of application within railway administrations in general which are already mechanised and where EDPM is later intended to be adopted.

According to the table in figure 1, the fields in which the greatest number of applications has been declared, are — apart from general accounting and cost accounting — stores accounting, payroll and staff statistics, freight and passenger traffic statistics, and mileage statistics for individual wagons in relation to Maintenance.

The fact that it is just these fields which have been the object of the greatest interest, even when it was a question of conversion from earlier mechanization to electronic data processing, is something I was able to notice during a study trip I made in the U. S. A. at the end of 1955. This has also been confirmed by information in trade magazines and other pertinent literature. It is regrettable that this circumstance could not be more clearly illustrated with details from various administrations in the U. S. A. because of the fact that the questionnaire was not sent to them.

In what follows now, I want to touch upon some special fields of application in connection with question 7, namely, Payroll accounting, Traffic revenue accounting, freight and passenger traffic statistics and, finally, Stores accounting and Inventory control. In the section Payroll, I have cause to talk about EDPM's main components and their characteristic qualities. Of course, what is more generally said there, applies also to other applications dealt with. The section on Traffic revenue accounting is based essentially on own practical experience obtained while using, on a service basis, the electronic data processing machine IBM 650 for Traffic revenue accounting at the Swedish State Railways.

* * *

A. PAYROLL ACCOUNTING.

Calculating salaries and drawing up accounting documents in connection herewith, may appear far too simple a task for EDPM, if the complexity of payroll

accounting is not borne in mind. Payroll work includes determining how long the employee has worked, calculating earnings and taxes, and making deductions for taxes, superannuation contributions, trade union quotas, etc., in order to obtain the net salary figure. Apart from all this, the work also includes the important task of supplying the management with much information, based on numerical salary material, in statistical or other form for various administrative purposes.

Payroll is, as we well know, one of the classical applications for the punch-card technique. The advantages of the punch-card system are no doubt well-known, but as EDPM develops these even further, I would like to repeat some of them in brief. When the actual punch-cards are once punched and checked, they are permanent, unalterable and they eliminate mistakes arising from disappearance or rearranging of data. Sorting machines take over the work of arranging primary data — which becomes expensive if carried out manually — and reduce errors caused by incorrect sorting. Summation punchers automaticaly produce cumulative information and eliminate the time-consuming and expensive manual work of pricing, checking and calculation of time cards. Tabulators can quickly list pay checks or envelopes and reports on calculated earnings and deductions and also produce documents for informative and control purposes. Punch-card calculators carry out the arithmetical operations that are involved in payroll work more quickly and with greater reliability than with manual or simpler mechanical procedures.

However, if one compares the pure punch-card system with a system which incorporates electronic computers as the central part, the latter system — no matter if it employs punch-cards as in- and output material or not — shows itself to be decidedly superior, by reason of EDPM's speed, accuracy, great internal memory capacity and program steering. EDPM has proved to be particularly useful in highly repetitive operations requiring access to a great deal of information.

With regard to its complex but also highly repetitive character, payroll is an application where EDPM relieves office personnel of monotonous routine tasks to a greater degree than earlier machines did. EDPM carries out these tasks faster and more effectively than any other manual or mechanical aid. By means of their ability to perform long series of work operations within themselves, EDPM also eliminates the physical transference of data from one process stage to the other.

The advantages of EDPM for payroll application are already apparent on the input side, that is to say, the transference of primary data to the machine.

Both the great amount of the actual basic material (punched cards, magnetic tapes, paper tapes, etc.) and the number of separate factors involved therein, can be considerably reduced because of the possibilities of storing in advance fixed values (rates, wage grades, percentages, etc.) in table-or other forms in the internal memory and also working out and temporarily storing intermediary information for the continued calculations.

If often happens that the basic material need not undergo any special sorting but can be fed in in random sequence, since the storing capacity of the machines and their great testing power make it possible for them to identify the correct data at determined times in the course of operations.

There need be no removal of exceptions and anomalies by special reporting as the machine can be instructed to deal with these cases by branching to special operation sequences after logical decisions made by the machine. Thanks to the great memory capacity of the machines and their usually very short access time, the same input-data can be quickly and accurately used, to a far greater extent than with other procedures, for obtaining by-products of the actual payroll accounting, for instance,

personnel statistics, distribution of costs, etc.

Input can be carried out at the same time as computing, output and listing of data.

Finally, because of the high working speed of the machines, the time between the compilation of the input material and the payment can be cut down.

The control unit in an EDPM-system, i.e. the unit that conveys the fixed instructions to the memory and the arithmetical organ and directs the operational sequences, makes possible a hitherto unknown automation of payroll accounting. Obviously, the programming must be preceded by careful and necessarily time-consuming analyses of *all* details in the complex payroll system, but when the program is tested and ready, the machine can carry out all the operations it has been instructed to, quickly, accurately and without interruption and without any human intervention. It is obvious what this means in the question of payroll accounting if one remembers that an accurate calculation of payroll figures, payment at stated periods, etc. carried out manually, can only be made at the price of a great deal of expensive manpower. Even with a punch-card system, in spite of the mechanisation, a great many manual operations and time-consuming resorting of the card material are necessary. Perhaps the greatest importance of the programs in the payroll field still lies in the fact that they make possible immediate, effective tests of limit values and are thereby able to branch the order sequence for processing of payroll data according to varying conditions.

With regard to the *memory unit,* it may be generally said that it delivers the values needed by the control unit and transfers them to the arithmetic unit. It stores worked-out part results and delivers the final results to the output units. It can also store these final results in itself. At present, EDPM are available with quite varying internal memory capacities.

It would not be unrealistic to say that for the payroll application at railway companies — possibly with the exception of piece works — a capacity of about 20 000 digits would suffice to manage the work in one run in EDPM. Therefore, the majority of railway companies certainly need not consider anything other than the so-called medium-sized computers for payroll and similar applications. (For applications such as ticket booking, pre-notification of loaded wagons and stock accounting, both a large memory capacity and shorter access-time are probably required.)

It should now be clear from what has been said, that the large internal memory capacity offers many benefits in the payroll field. Above all, the memory provides the possibility of storing tables of rates, etc. and intermediary results, and of quickly taking out data needed during the course of calculation. Moreover, the large memory capacity frequently lends itself extremely well to taking the relations in the tables and using the hyper-fast counting ability for work according to programmed forms. This presumably applies to many railway companies when it comes to tables for overtime, remuneration of substitutes, deductions for certain times off, and deductions for withholding taxes. Compared with the punch-card system, EDPM offer the advantage of a minimal number of separate machine runs, thanks to the memory capacity.

The arithmetic unit performs the counting operations at electronic speed. The counting speed and number size for the four common counting methods, are usually more than enough for payroll work, but, on the other hand, eliminate the frequent need — which results in a loss of time — to divide both detail factors and final results in cases where ordinary punch-card calculators are employed. Among the advantages of the arithmetic unit is also its ability to carry out quickly sign tests and zero control for branching purposes. This is something that has proved to be of great use in payroll account-

ing with its complicated system with varying basic factors (wage groups, overtime rates, guaranteed earnings, high index groups, marital status, etc.).

The output unit receives the results of the machine's calculations and delivers them in a form that people or simpler machines can use. With regard to payroll, it can only be noted here that the results are usually so conclusive and differential that, without further processing, they can be directly and quickly listed in tabulators for various purposes.

What has been said about the benefits of EDPM for payroll accounting, are some general viewpoints, based mainly on information given in the literature found in that field, on comparative studies of EDPM's technical data, and on own experience obtained in programming work for EDPM. Only *five* of the railway administrations questioned have definitely stated that they have taken payroll accounting into consideration, namely, British Transport Commission, Egyptian Republic Railways, London Transport, Norwegian State Railways and Swedish State Railways. None of the administrations has yet installed any proper EDPM, but as far as is known, the Swedish State Railways will be the first to do so in the near future (IBM 650). It is impossible to draw any general conclusions from the answers sent in, although it is clear that everybody expects EDPM to offer considerable advantages in the mechanization of payroll accounting and such things as cost distribution and staff statistics that are connected with it.

B. TRAFFIC REVENUE ACCOUNTING, ETC.

In the answers to the questionnaire, the only concerns that have dealt with this application are Rhodesia Railways (rather summarily) and Swedish State Railways (more thoroughly). The following section of the report is based mainly on the Swedish experiences in this field.

In the field of traffic revenue, accounting and statistical work at the stations, checking and distribution work at the control offices and basic treatment work at the statistics offices can be rationalised by mechanical processing of data. Even conventional punch-card systems offer great advantages as compared with manual or simpler mechanical processing of the large amount of data generally encountered in this field. Installation of electronic data machines can provide still further rationalisation and also considerably improved information for settlement and statistics at lower costs.

Passenger traffic.

In the passenger traffic field, it is possible to build up, at a low cost, a uniform accounting system with effective control as long as the mechanical processing of the stations accounting employs a data machine. By using an accounting system of this kind, one can cut down, to quite a great extent, the accounting work at the ticket accounting places, obtain mechanically compiled basic material for settlement with other administrations, and also practical statistics. In the data machine department, special card-indexes are set up containing punch-cards, so-called relation cards for each occurring relation concerning readyprinted tickets and machine tickets and also for blanks for every type of ticket. The relation cards are pre-punched with all fixed details required for further processing. This pre-punching is of a non-recurrent nature and is carried out at the setting-up of the card-indexes. With the relation cards as a basis, ticket accounts are made centrally and sent out to the accounting places which have then only to complete the forms with sales figures. Two different types of accounting forms can be made up for the proper accounting at the stations. A special gross accounting is made for all tickets, whereby no attention is paid to cancelled tickets or half-ticket vouchers. For accounting of these last two items, a deduction account is used on

which the station counts the amounts it has to credit itself with for cancelled and half-tickets. Special accounting of tickets in separate accounting groups is not required; all tickets are to be found on the same accounting list, no matter if they are travel tickets, excess fare tickets or baggage surcharge tickets. The station need not even state whether the tickets were issued in transfer traffic as the necessary distribution of charges is made in processing in the data machine department.

When the accounting forms completed by the accounting places have been returned and the control office has checked newly-created and concluded number sequences, the real punch-card processing can begin. It should be noted here that the amount of punch work necessary for ready-printed tickets and machine tickets, namely, punching of outgoing numbers and a marking code for concluded or started number sequences, is very little. If the statistical data necessary for processing take up a limited number of columns, the relation card can be used for three or four periods accounting, after which the fixed details on the card are mechanically reproduced on a new card.

The following is gained from the relation cards for ready-printed tickets :

a) Production of new accounting lists as a basis for the next accounting;

b) Complete control;

c) Complete distribution with foreign administrations;

d) Statistical data for the preparation of more developed statistics.

It is checked mechanically that :

a) Ingoing number agrees with previous period's outgoing number;

b) The difference between outgoing and ingoing number is equal to the number of tickets stated;

c) Correct rate is used for each station's relation;

d) The charges for each relation are correctly calculated. Number times rate;

e) The accounting is correctly added. Error lists which note differences for incorrect accounting during machine processing are sent from the data machine department to the control office. Furthermore, the data machine department can produce a share list containing calculated shares for the foreign administrations concerned.

Data processing for accounting of readyprinted tickets.

One possible way of data processing accounting of readyprinted tickets is illustrated in the flowchart in figure 2. This chart shows the different phases in processing, from primary material to selection of error cards, distribution cards, statistical cards, etc. In addition, a block diagram is presented in figure 3 showing programming in general.

Statistical results.

The electronic data processing method makes possible a comprehensive division of material from different points of view. Without any appreciable increase in costs, statistics that are more detailed than before are quickly obtained. As mechanical control craves identification information which, in some parts, coincides with a statistical division of the material, a ticket code can be devised which renders possible an initial processing of ticket accounting for control, settlement and statistics. The statistical reports one can imagine as end products of electronic data processing, could be, for example, as follows :

a) Sales report with sales figures per sales place;

b) Operation control report consisting of an enlargement of the sales report;

c) Certain statistics per region or section;

d) Special statistics for local traffic, certain relations or something similar;

e) Result statistics with total sums worked out per ticket type for each accounting place;

f) Tariff statistics.

Machine tickets and blanks.

The data processing of machine tickets, i.e. tickets printed in ticket machines at the station, is in principle similar to the processing of ready-printed tickets. The benefits of this system, however, are not so tangible when it comes to machine tickets, as the stations need not reckon out the same sales figures for these tickets as for ready-printed tickets. A collection control by data processing machine is thus unnecessary, but the statistical division can, without difficulty, be made as comprehensive as for ready-printed tickets. It is not advisable to base punch-card processing of blanks on the stubs (counterfoils), unless statistical information is required for every ticket. On the other hand, a certain control and statistical work on the total amounts of each ticket type can be done in punch-card machines, in which way it becomes possible to make up a uniform accounting system for all types of ticket.

General questions in connection with data processing of passenger traffic accounting.

The time required for direct investigation work in conection with planning of data processing of passenger traffic accounting, can be estimated at 1 ½-2 man-years. To this is added a follow-up time of about 6 months for setting up a basic card-index system, drawing up regulations, forms, etc.

The basic notation work for passenger traffic accounting, which becomes relatively costly for most applications as basic data must be collected at every processing occasion, is greatly reduced. This is due mainly to the fact that the unalterable details are taken in only when setting up the card-index. A data processing system according to the principles described above, offers considerable savings in costs through a direct reduction of labour. Even if the calculation of costs plays an important part when judging the work methods described, the profitability should not be judged by the direct savings in costs alone. The further advantages that a system of this kind can offer should also be given due thought.

The following, for example :

— Quicker and improved statistics;
— Flexibility in the processing routines;
— A uniform accounting system;
— A considerably simplified form procedure;
— Simpler accounting regulation.

Freight traffic.

As with passenger traffic, mechanization and processing of accounts from the station can mean considerable benefits also for freight traffic. That part of freight traffic which is advantageous to process, is mainly loaded wagon traffic in which every consignment is of great value to the railway company from a control and statistical viewpoint. The limitation of the conventional punch-card machines means that a processing based on such machines is confined mainly to certain grouping of the material for the control office's checking work and production of statistical data, which do not generally allow detailed analyses. Moreover, the value of the statistical results is reduced because they cannot usually be collocated until a considerable time after the actual traffic month.

Installation of EDPM for handling of freight traffic accounting provides quicker processing which means that facts, essential to the management for judging situations, can be produced in time for direct action to be taken where necessary. A great amount of data for control and statistics is to be processed at every opportunity, and for this reason, an electronic data machine is particularly suitable as a

technical aid. When processing in the data machine, it is often possible to obtain results at the same time for control and statistical purposes, for instance, freight control and a simultaneous calculation of ton-km for every loaded wagon consignment.

From the control office's point of view, the data method is especially suitable for :

1. Freight control;
2. Collection control;
3. Control of conversion from foreign currency;
4. Distribution of transfer traffic.

With conventional punch-card machines, it is difficult to carry out control and distribution as per points 1 and 4 respectively without time-consuming machine work. With EDPM, all processing phases can be carried out in one machine run, which can also provide statistical calculations and groupings. However, one essential for a smooth working routine is that the complete procedure that comes before data processing, is adapted for the new method, e.g. freight documents, tariffs for freight computing, administration codes, etc.

The company board's demands for statistical information about freight traffic will be easily satisfied if the basic notations, from which the input-medium is compiled, contain all requisite data. Therefore, consideration must be paid to the requirements of those wanting the statistics when the statistical codes are planned. If the codes are adopted for these demands and the type of data machine chosen, there are excellent possibilities to make full use of the capacity of the machine to condense the great amount of basic notations.

C. STORES ACCOUTING AND INVENTORY CONTROL.

The following administrations have answered the questions concerning stores : South African Railways, Egyptian State Railways, Rhodesia Railways, Nigerian Railway Corporation and Swedish State Railways.

It appears from the reports sent in by the above-mentioned administrations, that inventory control is at present handled completely by punch-card processing of a more or less advanced type, but that EDP is being studied. However, there have been no detailed descriptions given of what plans have been made to solve the problems of stores with the help of EDP, or what advantages one anticipates that EDP will bring as compared with, for example, traditional punch-card processing. It seems that the studies that have been made in this field have not progressed far enough for anyone to venture to give an opinion of the actual method; only certain conceivable possibilities are described.

However, enough has emerged from personal discussions with representatives from administrations which have the matter under study to show that EDP-machines are expected to provide an excellent weapon in the struggle to rationalise and thereby lower the costs of storage.

It should also be pointed out that inventory control and payroll are the applications first considered when it comes to selecting fields of use for data processing machines. The explanation of this probably lies in the fact that the mechanisation of this work at several administrations has already progressed so far as to greatly facilitate a conversion to EDP-machines. Another contributory factor is the great amount of data re-occurring at short intervals in the processing schedule. What is expected of data processing machines is that methods and routines can be worked out with their help which will make it possible to keep the stocks at a level justifiable with regard to the company's general economic structure. This is thus to be accomplished by an effective control and estimation of the most economical stocks and purchase quantities. The routines would no doubt mean automatic correction of the order points by

Flow Chart, printed tickets

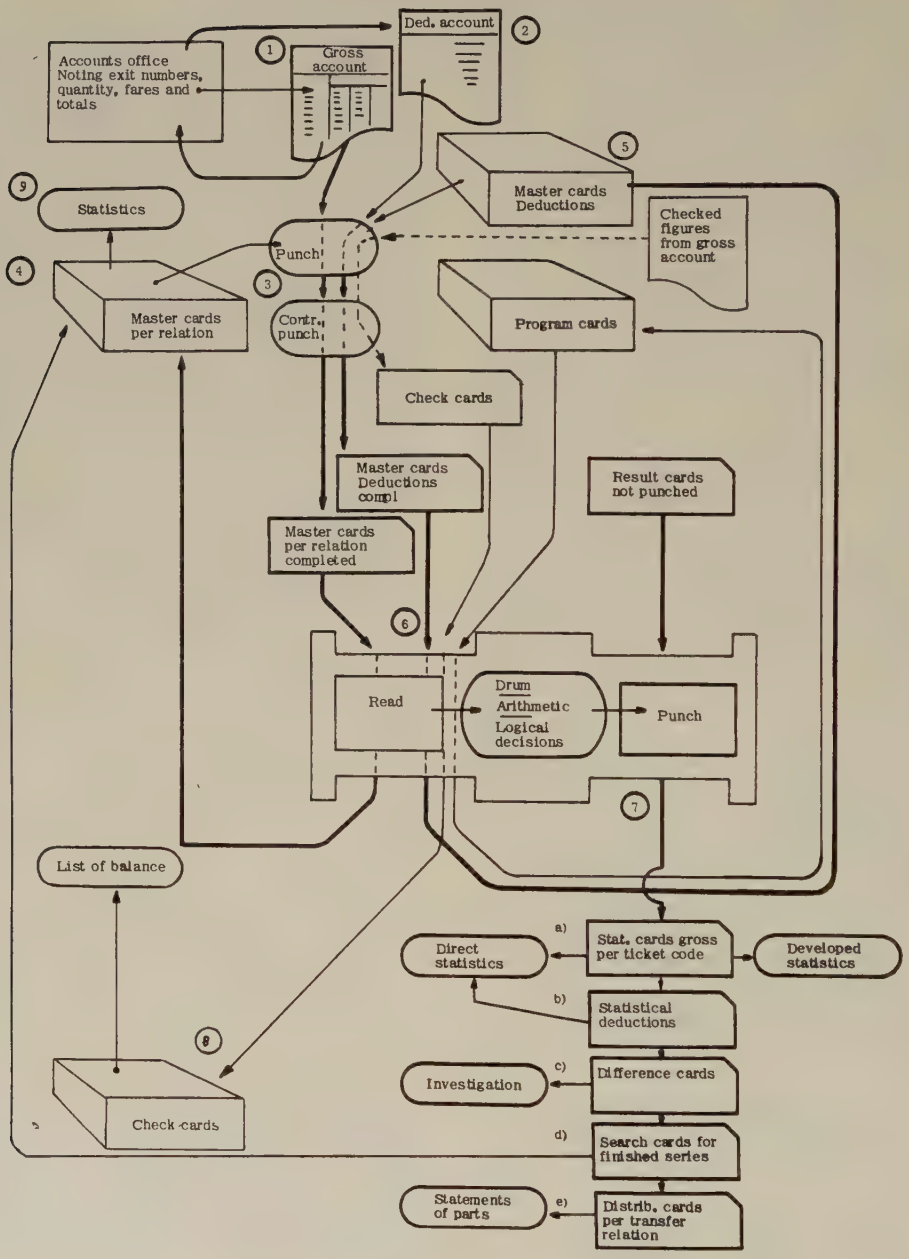


Fig. 2.

Block diagram

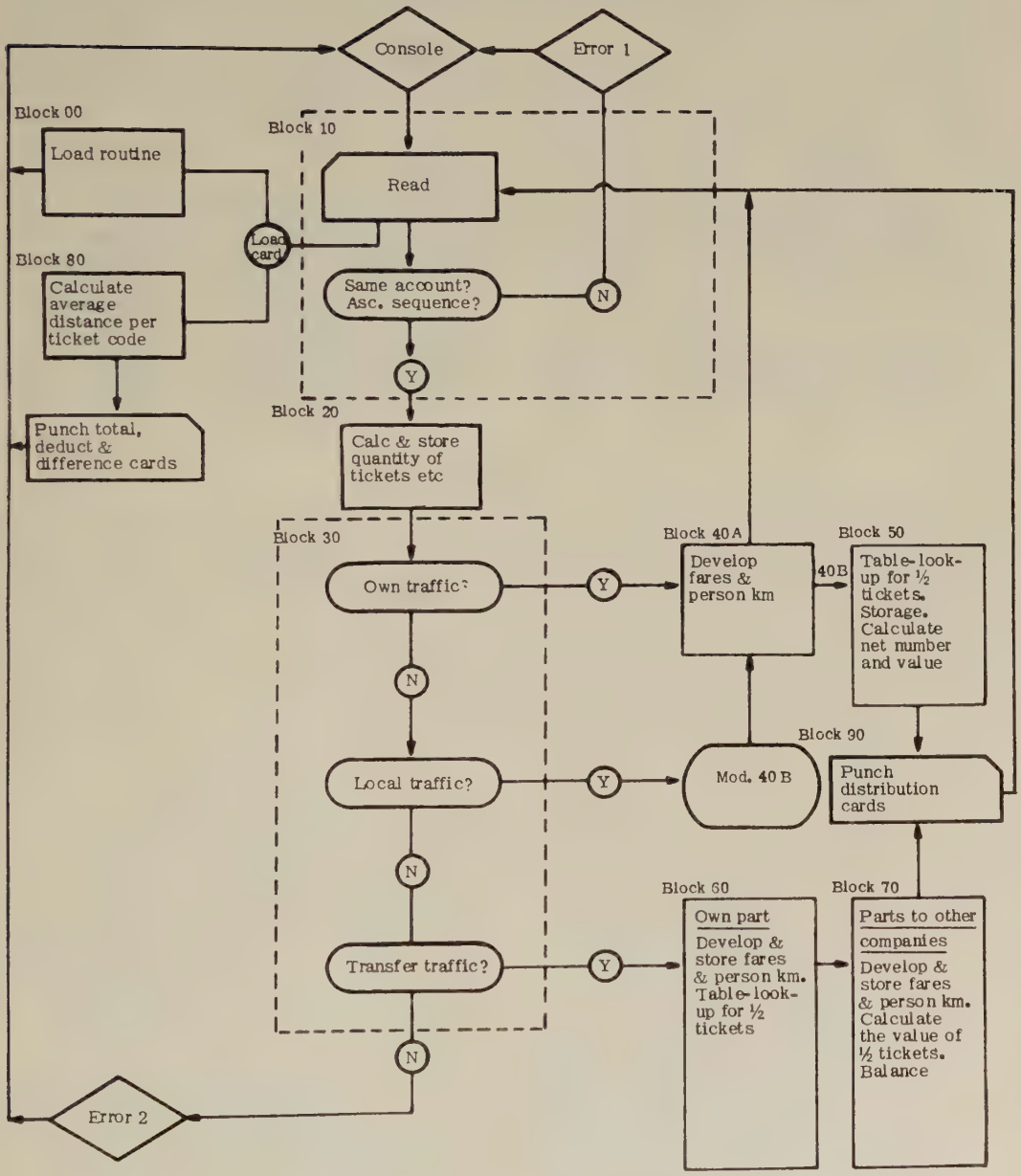


Fig. 3.

alteration of any of the variables on which the order point is based, signalling of impulse for ordering, so-called floating order point, and automatic calculation of purchase quantities. By means of this, it is expected to be able to reduce considerably stocks in hand and thereby release valuable capital tied up in them, and as a result of this, also reduce the company's interest expenses. It is true that this can be achieved, to a certain extent, without employing the EDP-method, but it is believed that this method will lead to better results and at a lower cost than with the aids used now.

When judging the advantages of EDP-machines on the stores side, attention must be paid to the speed of processing necessary in this field of application. Thus it is of the greatest importance to be able to get out up-to-the-minute reports from the EDP-department on the stock position, buying impulses in good time, order reminders, inventory requests, etc. Data processing machines also provide the possibility of preparing routines for calculation of average unit prices.

When looking at this report, it should be borne in mind that the studies and investigations of the fields of application dealt with here, that are at present being pursued by the administrations mentioned, are only at the analysis stage. Therefore, it was deemed advisable and necessary to give only some general views on the subject. With regard to this, is would seem expedient to take up the question for renewed discussion in due course of time.

[656 .212]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

17th. SESSION (MADRID, 1958).

QUESTION 5.

a) Handling facilities in the goods depots for consignments in less than carloads, containers. General arrangement of the depots. Liaisons between the staff of the depot and the delivery services.

b) Railway problems regarding the introduction of general palletisation of packages.

REPORT

(Austria, Belgium and Colony, Bulgaria, Cambodia, Czechoslovakia, Denmark, Ethiopia, Finland, France and French Union, Western Germany, Greece, Hungary, Indonesia, Italy, Lebanon, Luxemburg, Poland, Portugal and overseas territories, Rumania, Siam, Spain, Switzerland, Syria, Turkey, Viet-Nam and Yugoslavia),

by M. MARCHAND,

Ingénieur en Chef à la Division du Mouvement à la Société Nationale des Chemins de fer français.

FOREWORD.

The detailed questionnaire for Question 5, drawn up in collaboration with M. J. DORJEE, the English Reporter, was sent to 68 Member Administrations and 8 Member Organisations of Europe and their colonies, with the exception of the English-speaking countries.

— 24 Administrations replied to the questionnaire :

— the Deutsche Bundesbahn;
— the Austrian Federal Railways;
— the Belgian National Railways;
— the Lower Congo to Katanga Railway;
— the Colonial Transport Office (OTRACO);
— the Danish State Railways;
— Red Nacional de los Ferrocarriles Españoles (RENFE);
— the Finnish State Railways;
— the French National Railways;
— the Algerian Railways;
— the Franco-Ethiopian Djibouti to Addis-Abeba Railway;
— the Cambodian Royal Railways;
— the Viet-Nam Railways;
— the Greek State Railways;
— the Hungarian State Railways;
— the Italian State Railways;
— the Luxemburg National Railways;
— the Polish State Railways;
— the Portuguese Railway Company;
— the Swiss Federal Railways;
— the Bernese Alps Railways;
— the Rhaetian Railways;
— the Czechoslovakian State Railways;
— the Jugoslavian Railways.

— 13 Administrations stated that owing to the special character of the Operating, they were not able to supply any useful information.

— 31 Administrations did not reply.

We thank the Administrations who were good enough to reply to our Questionnaire, especially those who sent in very detailed answers, thereby facilitating the work of the reporter.

The present report faithfully follows the framework of the questionnaire sent to the Administrations; for this reason, we do not think it necessary to give the actual wording of each question.

The first four questions may appear to lie somewhat outside the scope of the question, but the reporters considered that it was of interest to collect certain general information :

— relating on the one hand to the relative amount of parcels traffic on the various Administrations, and the rhythm of its evolution;

— and on the other hand, about the general conditions under which the parcels traffic is carried, from the point of view of their repercussions on the handling services in the goods depots; the replies received in this connection showed in fact that the structure of the parcels transport and the methods used in labelling and sorting the parcels for example, dictate to a large extent the actual organisation of the handling operations.

Before beginning our analysis of the replies to the numerous questions asked, we would like to stress the fact that a large proportion of the study, we have carried out, is concerned with palletization in the handling of the parcels traffic, so that as a result it has certain points in common with Question II of the Enlarged Meeting of the Permanent Commission, held in Stockholm in 1952, which dealt with the use of pallets for the rapid and economic execution of door to door services.

Although the subject has thus already been examined from one special angle, it is of interest to compare the present report with that given by Messrs. SAUVAGEAT and DE BRUIN (*) at the Stockholm Meeting; this shows that if palletization has not yet developed everywhere, and if many Administrations who have gone very far in this field have not yet based their whole technique upon it, there has been very striking progress since 1952, and often on a considerable scale.

CHAPTER I.

GENERAL INFORMATION ABOUT THE TRANSPORT IN QUESTION.

1. Characteristics of the parcels traffic. - Its importance. - Its evolution.

All the Administrations class as parcels traffic those consignments which do not require for their transport the exclusive use of a wagon, or for which the consignor has not claimed the full load tariff. This traffic is therefore characterized in practice by the fact that loading, unloading, and if necessary intermediate transhipments are carried out by Railway employees (or the handling firms acting for them).

Certain Administrations have fixed weight limits but, most often, such limits depend on the actual tariff conditions, which are intended to encourage clients to send their goods in full wagon loads as soon as the tonnage reaches a certain level.

As regards the amount of the parcels traffic, the following table gives the necessary information for each Administration; as certain replies were ambiguous or incomplete, we had to take some of the figures from international statistics, in particular those of the I. R. U. (U. I. C.).

(*) See : « Congress Bulletin » for February 1952 and May 1952.

	Year	Tons carried				Percentage Parcels/ Total traffic
		Total freight traffic Full loads + parcels	Express parcels	Slow parcels	Parcels Total	
Algeria (CFA)	1956	6 193 000	not known	136 500	136 500	2.2
Western Germany (DB)	1956	253 000 000	390 000	4 550 000	4 940 000	1.93
Austria (ÖBB)	1956	46 250 000			533 000	1.15
Belgium (SNCB)	1956	71 149 000	657 000		657 000	0.92
Cambodia	1956	232 000			811	0.0034
Belgian Congo :						
Lower Congo-Katanga (BCK)	1956	1 855 000			334 000	18
(OTRACO-CFML)	1956	2 800 000 approx.				from 5 to 10
Denmark (DSB)	1956	6 114 000	no distinction made		754 000	12.3
Spain (RENFE)	1956	36 137 000	1 036 000	3 611 000	4 647 000	13
Ethiopia	1956	234 000			24 000	10
Finland (VR)	1955	19 159 000	110 000	957 000	1 067 000	5.5
France (SNCF)	1956	204 463 000	3 704 000		3 704 000	1.8
Greece (CEH)	1956	1 450 000	40 000 approx.	100 000 approx.	140 000	10
Hungaria (MAV)	1955	14 179 000			425 000 approx.	3
Italy (FS)	1956	53 765 000	604 000	1 128 000	1 732 000	3.2
Luxemburg (CFL)	1956	18 484 000	2 300	32 000	34 300	0.19
Poland (PKP)	1956	238 600 000			2 280 000	1
Portugal (P)	1956	3 974 000	139 800	657 900	797 700	20
Switzerland :						
Swiss Federal Railways (CFF)	1955	22 222 000	450 000	1 475 000	1 925 000	8.66
Bernese Alps Railways (BLS)	1956	3 795 000	62 000	169 000	231 000	6.08
Rhaetian Railways (RhB)	1955	480 000			68 000	14
Czechoslovakia (CSD)	1956	134 227 000				
Viet-Nam (South)	1956	350 000			7 000	2
Yugoslavia (JDZ)	1956	52 099 000	no distinction made		1 056 000	2.3

It will be noted moreover that the proportion of parcels traffic compared with the whole of the freight traffic varies very considerably : from 1 to 20 %, but it must be pointed out that these percentages may be considerably affected by the amount of traffic that is handled by grouping agents.

However it may be, the table shows that 8 Administrations have an annual parcels traffic of between 1 and 5 million tons; Germany (DB), Spain (RENFE), Finland (VR), France (SNCF), Italy (FS), Poland (PKP), Switzerland (CFF) and Jugoslavia (JDZ); in Austria (ÖBB), Belgium (SNCB), Denmark (DSB) and Portugal (P), the traffic exceeds 500 000 tons without reaching a million.

The general tendency is for the absolute value of this traffic to increase. However, certain Administrations report that this increase is slower than the progression of the national production index, so that it is probable that the increased traffic is largely enjoyed by competing methods of transport. It will also be noted that in certain countries there is a tendency for the parcels sent to become lighter and lighter and bulkier and bulkier, the consequence of certain traffic being collected by the grouping agents, or the « cream of the traffic » being skimmed by the road hauliers.

2. Organisation of parcels traffic.

The classic organisation of the parcels traffic is used by all Administrations of a certain size.

This organisation consists in dividing up the system into regions each of which is served by pick up or distributing trains — or, if needs be, by lorry. Each region has a centre for the transhipment of parcels and exchanging through wagons (through services) with other regional centres. In the case of extensive systems where it is not possible to exchange through services every day with all the other regional centres, variations to this organisation have been introduced which make use of intermediate transit centres at which the traffic to or from a varying number of regions is concentrated, according to the organisation. On the other hand, within the regions themselves, there may be secondary centres to save short distance traffic having to be routed via the regional centre.

The parcels traffic is forwarded by the *regular* parcels wagons which are run in regular services no matter how much traffic there is. These regular wagons are the bare framework of the organisation of the parcels traffic, the parcels being carried either in one of these wagons from beginning to end of their journey, or in several regular wagons in turn, being transhipped at the intermediate connecting yards, known as transhipment yards.

All the Administrations are taking steps on the one hand to reduce transhipment operations, and on the other to speed up such operations when they have to be retained. For this purpose, they draw up transport programmes which govern the forwarding of the parcels as a function of the times of the collecting trains and the organisation of the transhipment centres. Such programmes are revised periodically in order to take into account the evolution of the traffic and maintain the fastest possible transport with the minimum number of transhipments and the optimum user of the wagons.

In general the wagons specially set aside for the parcels traffic are divided into three groups :

— « *local* » *allocations :* these only hold parcels for a single yard;

— « *transhipment* » *allocations :* these contain parcels intended for a transhipment centre; sometimes parcels for the area round this centre are also included;

— « *collecting/distributing* » *allocations :* these collect over a section of line all parcels intended for a yard or centre or distribute parcels for yards where there is not sufficient traffic to justify a local wagon.

Exceptionally wagons can be used both for collecting and distributing parcels over certain routes.

When the traffic makes it necessary, « optional » wagons are run, either for a local yard, or for the regional centre, or over a section of line. The minimum weight of parcels for which an additional allocation is allowed varies from 1 500 to 4 000 kg according to the Administrations, according to the destination of the parcels (local yard, section of line or transhipment centre) and finally according to the type of traffic (fast or slow goods).

3. Principles adopted in forwarding parcels.

The forwarding of parcels from acceptance to delivery are governed by two different principles :

— the parcel carries a label which gives the different employees the information required to determine in which wagon it should be loaded;

— the parcel is accompanied by a waybill and loading and unloading is carried out by comparing parcel and waybill.

a) *Forwarding by the labels.*

Some countries limit the necessary information on the labels to the mere name of the destination station. This method simplifies labelling, which can be left to the consignor (Poland, Hungary, for example) but means that the staff handling the parcels must have a very extensive geographical knowledge of the system in order to determine to what transhipment centre the parcel must be forwarded.

Certain Administrations, in particular the Swiss Federal Railways and to some extent the Belgian Railways, give on the label the exact route the parcel is to follow by writing in code the name of the successive transhipment stations and the allocations of wagons in which the parcel is to be loaded. This method of operating in principle limits the initiative of the staff during the course of the transport but appears only to be acceptable on Railways where transhipments are relatively few.

Other Administrations limit themselves, by using a code, to showing on the label the destination of the parcel without any precision of the itinerary to be followed. For example, the S.N.C.F. has given each station a « wagon indicator », in principle unalterable, which includes a figure indicating the destination Region, the name of a town which is the centre of the wagon Region to which the destination station belongs or a number of 2 figures identifying the destination station or a group of stations served by the same wagon allocations. The label by itself therefore does not show in which allocation the parcel is to be loaded. But in each depot, the working papers make it possible to determine which allocation is to be used. If there is any modification in the routing, all that is necessary is to make the correct amendments on these documents.

It should be noted that no matter what labels are required by the Railway, the method of forwarding parcels by their labels makes it possible to speed up unloading at the transhipment centres, as handling can begin as soon as the wagon arrives in the shed.

b) *Forwarding by waybills.*

Other Administrations (in particular the German, Austrian and Danish Railways) use waybills for consigning parcels. This method presupposes a certain number of preliminary conditions.

It is necessary that the waybills be sent at the same time as the parcels, and even, if possible, by a faster route. Now at the large depots, at the end of the day, it is often difficult to complete all the waybills and enter them up by the time the wagons leave. Unless there is some direct and rapid way of sending on the waybills, there must be a sufficiently long period between the time limit for handing in

parcels and the time of departure of the wagons.

On arrival at the transhipment centre, handling can only begin after a working programme has been prepared by the special office according to the information on the waybills.

This method makes it possible to determine exactly the work done by the handling gangs (output bonuses), to adapt the programme of wagons allocated to the traffic (running optional wagons, leaving important consignments in the original wagon, etc.) but it seems to us that the use of such a method considerably increases the work and may even put a brake on the rapidity with which the parcels are forwarded.

4. Rolling stock used.

Parcels are usually loaded in the ordinary type of covered wagons suitable for the kind of traffic (braking, tare, axle spacing). The only exceptions are for :

— goods which must be loaded in open wagons because of regulations concerning dangerous or inflammable materials, for example;

— parcels which on account of their nature, weight or size cannot be loaded into covered wagons.

In general, the Administrations use without distinction all the covered wagons available. However, as large capacity wagons are those in most demand, the Railways often try to make use of the small wagons for the parcels traffic except when the volume of traffic is such that the use of a large wagon will obviate the use of two small wagons.

It should be noted that in Federal Germany, Hungary and Poland covered wagons connected by bellows are used so that goods can be sorted during the run by travelling gangs, but it would appear that this is done solely in the case of wagons allocated to « Collection/Distribution » services.

In the same order of ideas, the Jugoslavian Railways use parcels trains (Dencartrain) composed of 8 large wagons connected by gangways. On certain lines, this train collects and distributes parcels at stations where there is not sufficient traffic to run through wagons. The sorting of the parcels takes place during the run.

CHAPTER II.

GOODS DEPOTS.

5. Arrangements adopted in the goods depots.

The goods depot services are part of the general parcels traffic and must therefore be governed by the same requirements of economy and rapidity in all shunting and handling operations.

The connections with the fans of sidings for the reception and despatch of the trains must be as simple and short as possible, the track arrangements and methods of working designed to simplify operation to the maximum extent; in particular, it is essential to reduce to the strict minimum delays between the arrival of the trains and the placing in position of the wagons, and between loading the last parcels and the departure of the trains : which presupposes the preparation and faithful observation of a working programme for each day's work.

On the other hand, the goods depots must be so arranged as to assure excellent accessibility for road vehicles, not only for the town traffic, for a long time the only road traffic that came into the picture, but also, as the D. B. stresses in particular for the lorries used for the substitute services (centre stations).

The arrangements generally adopted are as follows :

a) *for the despatching areas* (road to rail).

These areas include :

— bays where parcels are handed in;

— one or two areas where parcels are collected, and if necessary, a place where they can be stored till they are forwarded.

1) The bays where parcels are accepted are close to the parking area for the lorries bringing in consignments. They must be equipped with scales and possibly a label container. The amount of traffic determines the number of bays required side by side.

It is recommended to set aside a special area for heavy, bulky parcels so that the special lifting and handling gear as well as a weighbridge can be all kept together.

2) After acceptance, the goods are loaded into the wagons as quickly as possible, passing through the sorting areas if necessary; when local circumstances make it necessary, storage sites are provided for the parcels or pallets waiting to be loaded up.

b) *for the arrival areas* (railway to road).

The arrangements made depend upon the method adopted for classifying the parcels :

— sorted into bays corresponding to the road distribution zones, not forgetting to have a section for the parcels to be collected at the station;
— sorted onto numbered sites as the wagons are unloaded, the number of the bay being entered on the waybills.

c) *for transhipment areas* (railway to railway).

1) The arrangements adopted vary according to the size of the transhipment centres. When goods are handled manually, the area must be small as the hourly handling output is a function of the time spent in trolleying the goods and coming back empty.

In general, transhipment centres have several platforms and several parallel tracks. Except in small establishments, it is impossible in practice to have all the wagons to be loaded together in the depot at the same time, as this would mean extending the length and increasing the number of sidings to the detriment of the distances to be covered by the handling gangs. It is necessary to make a careful study in each case of the loading plans in order to limit the size of the goods depots.

2) When the amount of traffic justifies mechanisation, it may be advantageous to set up one or several sorting centres which will collect together for handling parcels from different places going to the same station or same group of stations. This sorting centre must necessarily be carefully sited in relation to the loading platforms and if necessary to the local consigning area.

If there is not too much traffic, it is best to have only one sorting centre. Its size will be a function of the number of different routes to be served, routes which will be represented in practice by trucks or pallets; free spaces must be left for sorters and traction or lifting machines to pass.

3) Finally sufficient sites or space must be left for :

— dangerous or inflammable goods;
— the parking or maintenance of the handling equipment (including battery charging posts or fuel pumps);
— the offices, when the local depot is part of the transhipment centre;
— the administrative offices;
— the social installations (canteens, washplaces and in exceptional cases, dormitories).

Each of these areas : consignments for despatches, arrivals and transhipment, may involve one or more independent installations, but the grouping of the areas has been done by most of the Administrations who replied, according to the following principles :

a) to make it unnecessary for customers and the collection and delivery services to have to go to several points at a distance one from the other in order to send off or collect parcels;

b) to avoid selection in services towards the station concerned by allowing the wagons to hold both parcels for the station (arrivals) and parcels for transhipment;

c) to do away with exchanges of parcels between different working areas;

d) to reduce to the minimum the number of handling operations within a given framework, and if possible the distance parcels have to be moved.

Consideration *a*) results in avoiding having a multiplicity of consignment platforms and arrival platforms assuring the same function and consequently having, no matter what the size of the station, only one consignment platform and one arrival platform.

Consideration *b*) results in making provision on the same siding for the unloading of parcels for the station and parcels for transhipment, and consequently the juxtaposition of arrival and transhipment in a single installation.

Consideration *c*) is in part met by such a grouping, but as it is also of interest to load the consignments of parcels in the same wagons as the transhipped parcels, it also leads to an amalgamation of the transhipment and consigning installations.

This explains why the great majority of the Administrations have been led to group the three functions together in a single whole known as « Single goods depot ».

However the realisation of a single goods depot of sufficient size to accommodate : Arrivals, despatches and transhipment has as its corollary an extension of the handling distances, which is contrary to consideration *d*). This increase in the distance is, however, a minor fact compared with the economies obtained by the concentration in question, and the corresponding drawback is considerably reduced by mechanisation.

The S.N.C.F. stresses that this concentration has been greatly facilitated by the introduction of the « speeded up regime », which now includes all the parcels traffic, the old grouping of fast and slow goods having been suppressed.

Most of the Administrations, even those who have no such single depots, are agreed in recognising that the grouping of the functions is desirable. Portugal does not share this opinion but does not explain why. The Lower Congo-Katanga does not think such an arrangement rational, and fears the risk of bottlenecks and mistakes.

The figures hereafter give diagrams of the working principle of a single goods depot.

Single goods depot with platforms.

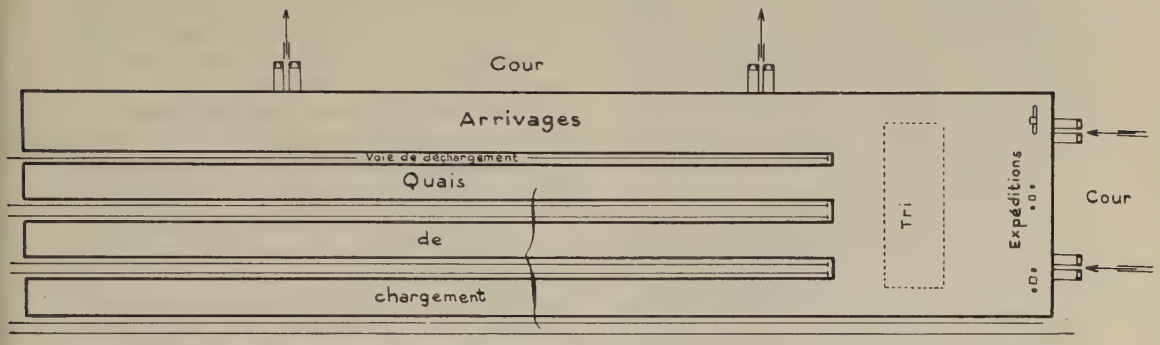
All the service sidings : loading and unloading, are deadends and the handling platforms are connected together by a huge end platform, so that the whole series of platforms forms a U with several branches. The end platform connects all the individual areas; it is also used as a consignment despatching platform; as for the arrival services, these are carried out on the wide side platform which has a courtyard.

One of the depots of this type in use on the S.N.C.F. deals with a daily traffic of :

— 90 t for the despatches area (road to rail);
— 80 t for the arrival area (railway to road);
— 480 t for the transhipment area (railway to railway).

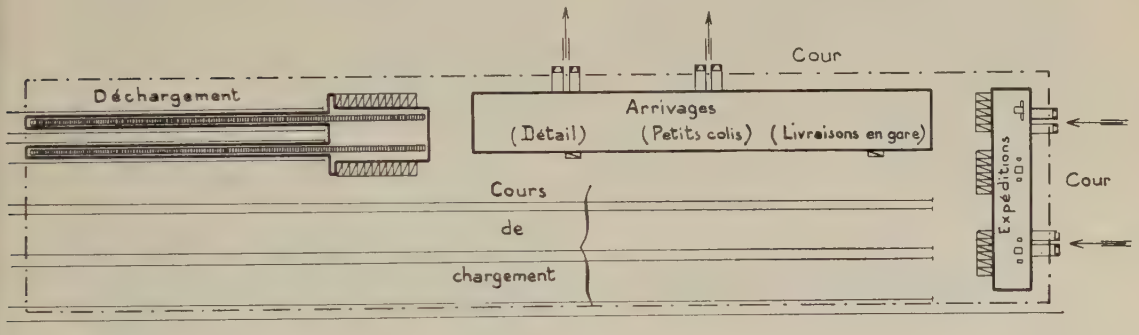
It should be pointed out that in depots of this type on the D.B., the sidings between each platform are separated by a narrow path. One such depot assures a daily traffic of :

Single general purpose depot with platforms.



N. B. — Cour = yard. — Arrivages = arrivals. — Voie de déchargement = unloading siding. — Quais de chargement = loading platforms. — Tri = sorting. — Expéditions = consignments.

Depot without platform.
(Arrangement used on the S.N.C.F., D.B. and Danish Railways.)



N. B. — Déchargement = unloading. — Cour = yard. — Arrivages = arrivals. — Détail = parcels. — Petits colis = small parcels. — Livraisons en gare = station deliveries. — Cours de chargement = loading yards. — Expéditions = consignments. — Chariot intérieur = inside truck.

— 87 t for the despatching area;
— 55 t for the arrival area;
— 607 t for the transhipment area.

Depot without platforms.

Such a type of depot is only found in France in the case of the installations of Administrations covered by our questionnaire (1).

(1) Depots without platforms were invented in Great Britain.

This is essentially for very large depots whose daily traffic could not have been dealt with in the classic type of goods depot before the introduction of palletization. The basic conception is to shift the parcels by means of larger types of vehicles than the classic trucks and move them alongside the wagons being loaded in order to distribute the parcels. A depot of this type consists essentially of :

— *an unloading area* with one or more conveyor belts 1 m wide set into paths

on which the vehicles to be unloaded are put; a platform, at the end of these belts, takes the 4 × 2 m distributing trailers (« plates-formes ») which can be coupled up automatically to tractors (each trailer corresponds to a loading siding or section of the « arrivals » platform (Small consignments, parcels, station consignments);

— *a consignment area* consisting of a shallow platform (7.5 m) facilitating checking operations, along which the distribution trailers are brought (each trailer corresponds to a single loading siding);

— *a loading area* consisting of 8 m wide yards surrounded by the loading sidings. The trailers (each for a single siding) distribute the parcels into the wagons according to destination;

— *an arrivals area* served by the trailers for this area.

A depot of this type, in service on the S.N.C.F., deals daily with:

— 200 t for despatches (road to railway);

— 160 t for arrivals (railway to road);

— 800 t for transhipment (railway to railway).

In a similar depot which does not deal with any arrivals, the tonnage handled in 16 hours exceeds 2 000 t.

* * *

6. Essential characteristics of goods depots.

The size of the depots depends not only on the tonnage handled but also on the nature of the traffic to be dealt with. Obviously, a depot in which arrivals for collection at the station predominate and involve storage will have to be larger than a depot where, as on the S.N.C.F., parcels arriving are delivered home immediately; just as a depot which deals mainly with consignments handed in directly by customers which involve checking and labelling, will have to be larger than a depot to which parcels are brought from a town office already mostly checked and labelled.

Account also has to be taken of the distribution of the traffic in time: seasonal and daily peaks. The tonnage to be taken into account in determining the areas that will be required is obviously that with which each depot will have to deal at its busiest times.

As regards the area required in terms of the tonnage handled, opinions vary from one Administration to another, according to whether they include or not the areas required for trolleying, but the majority of Administrations agree that a greater area is required for arrivals than for consignments, for the same tonnage.

To get some idea of the size, it may be stated that every ton a day to be handled involves (including area required for trolleying):

a) in the case of despatching platforms 14 to 15 m²;

b) in the case of arrival platforms, about 20 m²;

c) in the case of transhipment platforms, 12.5 m².

Certain Administrations, in particular the D.B., point out, moreover, that the progressive introduction of the 5 day week will involve longer standing of goods on arrival, and therefore a larger area for arrivals.

The total length of the sidings with platforms depends above all on the number of wagons that have to be put on them simultaneously:

— to be unloaded (arrivals and transhipment);

— to be loaded (transhipment and despatches).

The number of wagons to be placed simultaneously alongside an unloading platform depends, for a given volume of traffic, on the *time* allowed for this operation, and consequently upon the daily number of trains.

The number of wagons to be placed

simultaneously alongside a loading platform depends above all on the method of handling used; according to whether loading takes place into the wagon directly or with intermediate stowing, it is necessary to have a larger or smaller number of wagons alongside the platform. The first method is adopted more or less generally, although it involves keeping the wagons longer in the depot.

The width of the platforms varies according to the purpose for which they are used and the operating methods in use. The D.B. ([1]) states that the platforms should be 10 to 15 m and the arrival platforms 12 or 20 m. They consider a width of 8 m suitable for the loading platforms in *mechanised* depots. The S.N.C.B. has fixed a width of 16 m for the platforms (arrivals and despatches). This corresponds to the length of a 4.5 m wide bay whose area (including the conveyor belts) is sufficient to spread out 3.6 t of freight, i.e. the average tonnage of the delivery vehicle. A width of 6 m has been retained for the transhipment platforms.

The majority of the Administrations consider that the width of the arrival platforms should be greater than that of the despatch platforms, and that in the case of the loading up platforms, mechanisation necessarily involves an increase in the width.

When the sidings are short ones, the depot can be close knit, which is the most favourable from the point of view of trolleying and therefore gives the lowest handling costs.

On the other hand, when the sidings are long ones, the service operations and consequently the cost of shunting are reduced. Consequently, it is necessary, as a function of the available site layout to look for the compromise which will give in each case the minimum operating costs; at this stage in the studies, the method of handling plays a preponderant part, as mechanised handling which is but little influenced by the length of trolleying distance facilitates the use of narrower, longer depots.

Special mention must be made here of the type of goods depot without platforms, mentioned under question 5. In such depots, there can be no question of piling up the goods whilst waiting to load them; the only working system possible is to load directly into the wagons, which makes it necessary always to have at least one wagon being loaded for each destination served. The size of such depots depends therefore above all on the number of wagons that have to be simultaneously loaded. On the other hand, the part of the depot reserved for unloading is usually small in area whether unloading takes place alongside a pathway (average sized depot) or a mechanical conveyor belt (large depots). The rakes to be dealt with are usually short, as they can be brought up at frequent intervals. The areas reserved for consignment can also be smaller in size.

7. Conditions under which the loading and unloading of wagons or lorries take place (platforms, yards).

The loading and unloading of wagons and lorries must always take place at floor level, as in principle, handling should be with the minimum of effort, and so on the same level. This condition is more important in the case of heavy parcels, especially when containers and pallets are used.

In general, the platforms are higher on the track side than on the yard side. On the track side most platforms now vary between 100 and 110 cm; this has been progressively increased by most Administrations to 115 to 120 cm to avoid changes

([1]) The D.B. goes into the question of the type of flooring for platforms, stating that they prefer a continuous, smooth, non-skid even when wet flooring, which can be quickly and easily repaired. The materials they used: concrete, hard paving stones or concrete paving stones with some product to harden the surface, hard cast asphalt and pressure-compressed asphalt slabs have all stood up well in service.

in level which gives trouble with mechanical handling methods.

On the yard side the platforms are usually not more than 110 cm. It is difficult to find the ideal height, as the floor level of lorries is not standardised and varies very considerably from 90 to 165 cm. The D.B. keeps its platforms at 90/100 cm when horse-drawn vehicles are used for haulage, and 100/120 cm when lorries are chiefly used.

The differences in level between platform and wagon are made good by mobile steel light metal or wood, bridges. It is a good idea to fit such bridges with some device to prevent them slipping when containers on wheel, fork-lift trucks or pallet-holders are used.

Between platform and lorry, where the difference in level may be much greater, the difficulties are solved by using extensive loading bridges or bridges on hydraulic jacks (a costly solution which lacks flexibility of working) (D.B., S.N.C.F., C.F.F.).

In depots without platforms, the S.N.C.F. uses for the transport of parcels, trailers whose floor level corresponds with that of the wagon floors, taking into account the level of the yard compared with the rails; these trailers are in fact mobile platforms.

8. Multiple platforms.

The problem of the connection of multiple platforms is linked with that of the general layout of the depots, as there are two types of depots with multiple platforms :

— through way depots;

— dead end depots.

Through way depots, open at both ends, make it possible to run certain parcels trains directly up to the platform, or in certain cases to simplify the shunting and consequently speed up the forwarding of the parcels. But on the other hand they imply a double connection with the main lines and make it necessary to assure connection with the platforms systematically by means of the mobile bridges dealt with later on; through-way depots only appear to be used exceptionally, and it does not seem that this type is under consideration for any new depots.

Dead-end depots, which are easier to site, usually have an entrance platform which has the advantage of giving access to each platform independently of the state of occupation of the sidings, and which is the best site for a sorting centre when this is required. The entrance platform is designed as a wide passage for the handling trucks, but it increases the handling distances and becomes insufficient when the length of the installations increases.

In all through-way depots, or in those dead-end depots where it is necessary to shorten the trolleying distances, most Administrations use electrically or hydraulically driven mobile bridges, which during shunting are housed above the track, under the platform or perpendicularly to it. Safety measures must co-ordinate the shunting of the rakes and the bridges.

If there are no such bridges, specially designed flat wagons placed at suitable positions in the rakes of wagons for loading or unloading make it possible to cross over the track. All the Administrations, however, are unanimous in recognising that this is only a makeshift solution, in view of the additional shunting involved in bringing up and removing these flat wagons when working on the track in question.

Finally, the hypothesis mentioned in the questionnaire of serving a platform from a track which is not adjacent to it by passing through wagons on the adjoining track, is only used exceptionally owing to insufficiency of certain installations. In the opinion of all the Administrations, putting the wagons into position so that all the doors will correspond on 2 adjacent tracks wastes a lot of time. The bridges used have to be very strong; they are dif-

ficult to handle and are a serious accident risk. The D.B., the S.N.C.B. and the Danish Railways make it quite clear that they forbid such bridges to be used with fork-lift trucks.

9. Areas reserved for door to door delivery services.

Certain Administrations, in particular the S.N.C.B. and the S.N.C.F. deliver goods to the premises of the receiver without other formality, unless asked not to. Naturally, the overall area to be reserved for arrivals to be delivered to domicile will be greater than that reserved for arrivals to be held at the « station », which are in the minority.

In general, the part of the depot reserved for delivery to domicile is divided up into as many bays as there are delivery zones, each bay being served by a door in front of which the lorry in question parks. The bays are perpendicular to the lorry parking space.

On the S.N.C.F., where parcels weighing less than 50 kg come under a special regime and require no waybills, the parcels in question are usually sorted separately in the arrival areas and very often delivered to domicile in special delivery vans.

The D.B. state that their official haulage services, when the daily tonnage is more than 15 t have a *covered-in* yard, which is either attached to the arrival depot of the station or separated by a screen from the rest of the arrival depot.

The Administrations agree that it is necessary to provide an average area of 20 m² per ton for the delivery to domicile services (this figure includes the necessary trolleying areas). In general, each bay is spaced 1.5 to 2 m apart to allow the parcels to be moved about by trolley. The C.F.F. stipulate 1.60 m for non-mechanised working and 2 m for mechanised working. The S.N.C.B. stipulate 3 m.

Mention must be made of the fact that there is another method in which no distinction is made between parcels arriving for delivery to domicile or for the station. The parcels are stacked in whatever space is available when they are unloaded. The depot is then divided into a certain number of numbered bays in which the parcels are stacked, the number of each bay being entered on the corresponding waybills. This method presupposes in particular that the waybills come in at least at the same time as the parcels, as they have to be checked against the parcels when these are unloaded. It is used in particular in the palletized depots of the C.F.F. and on the Lower Congo-Katanga Railway.

10. Areas reserved for goods collected at the station.

Most Administrations provide special bays in the part of the depot reserved for arrivals to be collected, for :

— each of the important hauliers, where the parcels are stacked without being arranged according to destination;

— certain consignors who receive a large tonnage every day.

The bays in this case are marked by painted letters on the floor and name plates. Parcels for customers who only collect a small tonnage or occasional customers are put in special bays. There must be some system of classification making it possible to find the parcels easily. Mention may be made of the system used by the C.F.F. mentioned under a previous question, and the classification by the last number of the consignment number used by the R.E.N.F.E.

The bays are perpendicular to the parking spaces for the lorries. There is a space of from 1.5 to 2 m between them to give room for trolleying the parcels.

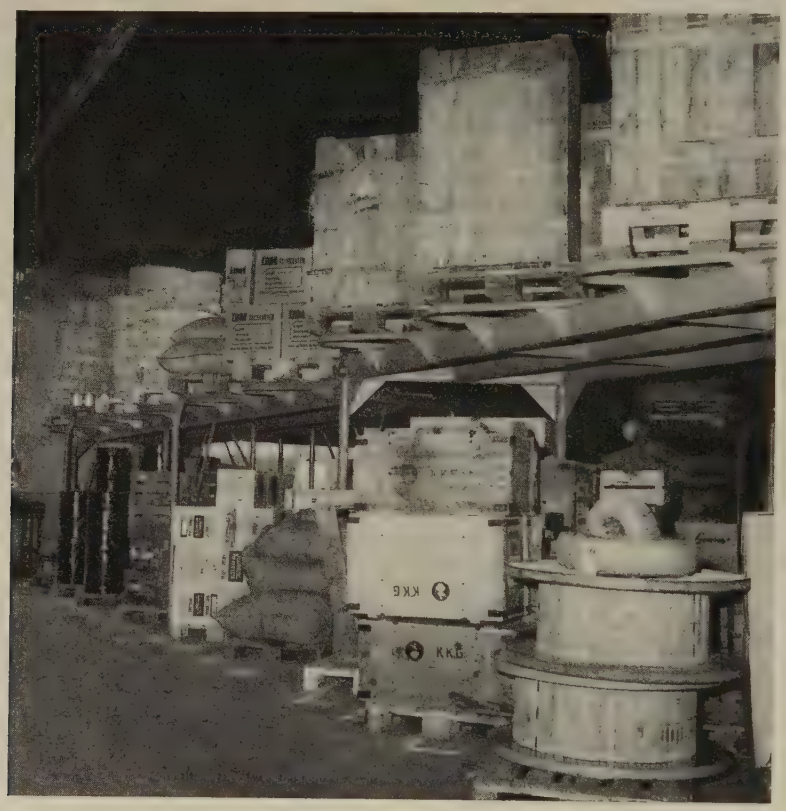
As for the area to be allowed for storing the goods, the Administrations give no figures apart from Luxemburg which mentions 35 m² per ton and Jugoslavia 12 m²

per ton (actual area required not allowing for trolleying room). However, the S.N.C.B., the S.N.C.F. and the R.E.N.F.E. consider that a greater area is required, for equal tonnage, for goods consigned to « station » than for goods consigned « home », as the parcels may be left longer in the depot.

This consideration makes it necessary to provide larger installations. On the other hand, the checking into the different bays, finding and handing over the parcels to customers are expensive in labour.

To sum up, immediate delivery home has considerable economic advantages, as it makes it possible to reduce the size of the installations and simplify the sorting of the parcels on arrival.

As regards storage facilities, only the C.F.F. whose parcels traffic is completely palletized use metal racks for pallets where ever there is a shortage of space. The D.B. intends to experiment with such equipment in the near future. Other Administrations report the use of racks for small parcels or foodstuffs (Spain, Denmark, Greece, Lower Congo - Katanga, O.T.R.A.C.O.). Special closed premises can be provided for surplus parcels, and spoilt or damaged goods.



Switzerland. — Shelves for pallets arranged in saw tooth pattern.

11. Ventilation of goods depots.

All the Administrations agree that parcels must be dealt with in covered in depots.

Certain Administrations, such as the D.B., consider in addition that it must be possible to lock up depots in which business is transacted with customers « collecting » and « consigning » parcels.

Other Administrations, such as the S.N.C.F., only close the depots in regions where the climate is severe on where there are strong winds.

However even in these closed-in depots there are nearly always a sufficient number of doors kept open during long periods (Posts at which parcels are accepted or collected, openings for wagons to come into the depot) for no ventilation problems to arise.

The use of tractors with thermal engines is not likely to be harmful unless they are employed in very large numbers. In such cases, however, the Administrations prefer to use vehicles with electric motors rather than embark on forced ventilation of their depots. The D.B., which has experimented with such forced ventilation in the depots at Hanover, was not particularly satisfied with it.

In the case of perishable goods, wagons containing goods of this nature are specially marked so that they get priority unloading, and there is usually no inconvenience in dealing with them in the depot as such foodstuffs often suffer greater damage if they are not under cover. Exceptions to this rule are rare; however specially well ventilated areas sometimes have to be reserved for arrivals and consignments, especially in the case of fish which involves special cleaning facilities (provision of water pipes, special provision for draining and removing refuse, etc.).

CHAPTER III.

HANDLING (METHODS AND EQUIPMENT).

12. Operating methods in force.

A. Consignment area (road to rail).

When customers arrive at the depot with a consignment, an employee of the Railway checks the parcels, notes the weights and marks and numbers, compares these with the waybill, and also checks that they are properly packed.

In the case of Administrations, like the D.B., who do not use consigning labels, the employee checks that the label put on by the consignor includes all the necessary particulars. In other countries, he prepares and fastens on the label.

In a station where there is not much traffic, the parcel is most often taken directly to the wagon according to its label, but as soon as there is a certain level of traffic, it is no longer possible to take each parcel separately to the departure wagon and it may be an advantage to send them through a sorting centre where they are grouped together in units for handling, according to destination, on trucks, trolleys or pallets. Most often such units are then taken directly to the wagons where they are loaded.

However, in certain cases, it is necessary to store the parcels between the sorting centre and the wagons. This may be for two reasons :

a) The loading sidings may not be of sufficient capacity to put all the different wagons in place simultaneously. Obviously, in such a case, it is necessary to defer the loading of some of the parcels. It is then of interest to leave the loading of the wagons with the smallest allocation of parcels till the end;

b) Some loading has to be done with a special arrangement of the parcels, for example the heavy parcels and bulky

ones at the bottom of the wagon, the light ones above, foodstuffs near the doors, or arranged according to destination if there are several different consignments in the load. This method however has the double drawback of involving a large storage space and postponing the loading of the wagons till all the parcels are in, or a poor user of the staff. It can therefore only be used when local circumstances require it or the buildings make it possible.

The D.B., C.F.F. and the S.N.C.F. report that they use special gangs of packers who supervise the loading of the wagons, to consolidate the loads, by means of extensions, wires, wedges, anti-shock mattresses, fixing panels, straw, etc. These Administrations consider that the job done by these gangs is very important as on the homogenity of the load depends the conservation of the parcels and their arrival undamaged.

B. **Arrival areas** (railway to road).

Several methods are used by the different Administrations, methods which may be divided into three groups according to the moment at which the waybills come into the picture.

a) *Planning the work by means of the waybills before unloading the wagons* (D.B.).

In this case the goods office makes the necessary entries on the papers so that the parcels can be put in the right bay (factorage, agreed haulier, collection at the station, etc.). The papers are then given to the handling gang who must adhere to the orders they give. The initiative and knowledge of the handlers is therefore limited to the minimum, the whole of the work being prepared by the goods office, but this delays the time at which unloading can begin.

b) *Unloading from the waybills* (Ö.B.B., C.F.F., D.S.B., F.S., O.T.R.A.C.O., VIETNAM, etc.).

The handlers, who have the waybills in their possession, decide from the latter into which bay the parcel is to be put.

This method presupposes that each foreman has a thorough knowledge of the different delivery areas.

The handling gangs can if necessary enter on the papers the reference number of the bay where the parcel is put (case of Swiss palletized depots).

c) *Unloading according to the labels on the parcels* (S.N.C.F., C.E.H., R.E.N.F.E., etc.).

The handling gangs put the parcels in the bays according to the details on the labels attached by the consignor. This means that the foreman must have the same knowledge as in the previous case, but unloading can begin more quickly. Afterwards, checkers have to compare the parcels and papers in order to prepare the delivery sheets, if necessary using modern methods of communication between the depot and the goods office (loud-speaker, magnetophone, etc.).

C. **Transhipment areas** (rail to rail).

The principle governing transhipment centres is that the parcels arriving in a given wagon must be sent on by the next possible allocation, the time between arrival and departure being as short as possible.

Certain Administrations, such as the D.B., S.N.C.B., and Austrian and Hungarian Railways compare the parcels and their waybills, others, such as the S.N.C.F., C.F.F. and D.S.B. do not, the parcels being transhipped according to their labels (forwarding or consignor's label) without checking.

Whatever the method of handling, a certain number of operating rules are enforced by most of the Administrations :

a) it is of value to have several unloading sidings to avoid having to stop work whilst the wagons are being removed;

b) it is often preferable to divide the staff into three specialised jobs : unloading, trolleying, and stowing, rather than have the whole cycle carried out by one man;

c) the position of the regular wagons leaving the depot should always be the same, so that the trolleymen do not have to look for their wagons, which should also be very clearly marked by an inscription or better still a removable notice;

d) in order to keep trolleying distances down as much as possible the wagons which get the most parcels should be placed as close as possible to the unloading wagons, but this rule will complicate shunting. On the other hand, if the wagons were always grouped in the depot as a function of the shunting to be done in making up the trains, the trolleying distances might be greatly increased. The proper solution is a compromise between the two methods, in each case respectively to get the best overall results;

e) in the case of routes with several departures a day, the wagons are put at the top of the siding where their withdrawal will cause no inconvenience.

As regards handling and sorting, the simplest method is to take the parcels in the order in which they come from the wagons and take them straight to the departure area on the trolley. This method is still widely used in the small depots and is expensive in labour costs, as the output is very low and declines still further the longer the distance travelled.

For this reason, trolleys have often been replaced by three or four-wheeled trucks which cut down the number of runs but means sorting the parcels to some extent on unloading. As soon as the size of the depot increases, it becomes of value to send the trucks to the wagons being loaded in rakes hauled by tractors. Such trucks can be replaced by flat trailers or pallets belonging to the centre.

13. Machines and equipment used.

In goods depots of small and average size, handling is mainly by means of trolleys of 250 to 1 000 kg capacity. The types used vary not only from one Administration to another but often in the same Administration. However, it may be stated that there is a tendency to lighten the trolleys by the use of non-ferrous metals and that the wheels now have roller bearings or similar, and in many countries hard rubber tyres. However, in certain particular cases, due above all to the nature of the ground, cast iron types still have their partisans. It should be noted that for special types of goods to be handled (linos, metal sheets, sacks, etc.) the trolley can be fitted with movable accessories (particularly in Germany and Switzerland).

In somewhat larger depots, mention is made of the use of trucks with a movable fore-carriage (S.N.C.F. for example) and 3 or 4 wheeled trucks which can be used separately.

The choice of trolley or hand truck depends on the distances to be travelled and the nature (shape and weight) of the parcels to be handled. It should be noted that parcels put on a truck are not on the same level as the floors of the wagons, which may be annoying when handling heavy parcels.

As soon as the size of the depot justifies it, use is made of truck-trailers which can be used in rakes hauled by a tractor. These are sometimes fitted with automatic couplings and nearly always have rubber tyres. They can take loads of 1.5 t usually.

The tractors used have thermal engines (France) or electric motors (Germany,

France, Switzerland). The load hauled is usually 5 t. These trucks have to be very manoeuvrable and in particular must be able to turn in a very small space.

Motor trucks are used in Germany (progressively being replaced by fork-lift trucks), in Poland, Hungary and Austria. They are equipped with electric motors and can take loads of up to 1 500 kg.

In the depots without platforms of the S.N.C.F., handling in the yards is by means of 8 m² trailer platforms (2 × 4 m), hauled by electric or petrol driven tractors or carried by special motor trucks fitted with lifting devices. The loads of such platforms may be 1.5 to 2 t.

Special handling (heavy or fragile parcels) is done by means of machines adapted to the nature of the parcels :

— runners and tippers for heavy materials, but the palletization of such materials makes it possible to do away with these special machines;

— trolleys for bottles;

— special arrangements of tractor-drawn trucks for special traffics : long components, barrels, etc.

Mention must also be made of the use of motor cranes of 1 to 3 t capacity.

14. Methods intended to speed up the sorting and transport of parcels.

We will deal first of all with the sorting installations for small parcels : postal packets or small parcels in Belgium and France.

The S.N.C.B. at its Brussels-Midi Station where there is an important concentration of postal packages of a maximum weight of 5 kg, has a sorting installation using a turntable. The parcels to be sorted are put on a conveyor belt and taken onto a central ring, 10 m in diameter with a continuous rotary movement. Twelve roller and belt conveyors are taken off this ring. Each of them serves 2 or 3 destinations according to their size (*30 in all*). The parcels pass in front of a gang of sorters sitting inside the ring. These sorters push the parcels onto the proper conveyor for their destination. There are sets of pigeon-holes at the end of each conveyor. Here a second gang of sorters put the parcels into the proper compartments. A third gang, on the other side of the pigeon-holes, put the parcels into sacks and load them onto three-wheeled trucks which are then taken away by electric tractors. This installation makes it possible to deal with an average of 3 000 parcels an hour (about 9 t) using a gang of 25 men. At peak periods, a rhythm of 5 000 parcels can be obtained by increasing the strength of the gangs. The hourly cost (power, maintenance and sinking fund) is about 1 h 33 of the average hourly wage.

The S.N.C.F. at Paris-Batignolles Station has an installation meeting similar requirements. It is a question of sorting for some thirty destinations postal packages and small parcels, i.e. parcels weighing on the average some 15 kg. The installation consists of a sorting table with two conveyor belts moving in opposite directions, each part being 70 m long and 0.80 m wide. The whole is 0.70 m above floor level. The parcels brought to the sorting table are chalked with a number by the zoners who slide them, according to their zone, onto one of the two conveyor belts whence they are taken by handlers who place them either in their delivery places, or on one of the trucks that will take them forward. This installation can deal with 7 000 parcels in an 8 h day, with peaks of 1 300 parcels an hour. At peak periods, the gang consists of 5 zoners and 6 sorters.

The most essential problem, however, and the most difficult to solve, lies in connection with the sorting and the transport of the parcels traffic itself, and includes parcels of all weights and all shapes.

As soon as there is any amount of traffic and the distances to be covered are appreciable, all the Administrations use rakes of trucks hauled by a tractor.

These are usually electric tractors; petrol driven tractors, which are a bit faster, are also much appreciated.

The D.B. states that it has given up using conveyor belts owing to the increase in the number of small containers now used, and above all on account of the adoption of palletization. They consider in fact that the use of elevator trucks and working with tractor-drawn rakes of trucks is often more flexible and more economic than working with conveyor belts.

« The use of both these methods (conveyor belts and elevator trucks) whose duties would in part overlap, would have resulted in neither of them being fully utilised, and the platforms would have had to be abnormally wide. »

The S.N.C.F. also states that conveyor belts intended to assure transport over a long distance as well as the terminal distribution alongside the wagons or lorries are costly to install and above all costly to operate, as in the distribution zone it is necessary to have a fairly large number of employees to take off the parcels at the right places.

It would appear that the same reasons have led some Railways to give up using mechanical chain conveyors. The D.B. stresses the fact that with the conveyor chain, in addition to the above drawbacks, there is the necessity for fitting all the small containers with additional devices to enable them to be hooked onto the chain.

However, it should be noted that though it does not appear that the conveyor belt should not be retained as regards its « transport » function for parcels between the arrival and departure platforms, it is still of value for « sorting » parcels on arrival. For this purpose, it is used in the depots without platforms for a preliminary sorting, which, followed by distribution makes it possible to get a flow of goods towards a large number of destinations.

In these depots without platforms, dealt with in questions 5 and 13, the conveyor belts travel at 0.25 m/sec, and have a capacity of about 25 t/h, i.e. 550 t a day, taking into account stops for maintenance.

The hourly cost of such a belt (not including the staff using it, related to the hourly cost of labour) is as follows :

— Sinking fund (20 years at 5 %) . 0.8
— Maintenance 1.5
— Power 0.7

It can be concluded from the above that the use of pallets, elevator trucks, rakes of trailers hauled by tractor, very flexible methods, with a high output and economical, have practically brought researches into other mechanisations to a standstill.

15. Machinery for handling pallets and pallet-containers.

The Administrations who have palletised their parcels traffic at the present time are using pallet-carriers and elevator trucks, and sometimes, for transport over long distances, trucks hauled by tractor.

1. *Pallet-carriers.*

The Administrations favour machines with a capacity of 1 t, hydraulically operated.

The D.B., however, used pallet-carriers with a useful load of 1 600 or 2 000 kg in depots which regularly deal with a large quantity of heavy goods.

Certain countries prefer bogie type pallet-carriers (Germany, France, etc.) which cope more successfully with irregularities in the ground or floor of wagons; others (Switzerland for example) prefer simple rollers which reduce the resistance on curves.

They all state they are satisfied with the material they have chosen, although to begin with certain difficulties occurred owing to defects in tightness of the oil pumps used.

It is recommended to fit an overload valve on the elevator cylinder in order to

avoid damage when the maximum load has been exceeded.

Annual maintenance costs are in general low, and do not exceed 5 % of the cost price; the amount of damage occurring depends largely on proper supervision and care of these machines.

However, hydraulic pallet-carriers are relatively expensive machines for small establishments which only use a few pallets, and research has been undertaken to equip such depots with simpler and more economic methods (mechanical pallet-carriers for example : D.B., S.N.C.F., ...).

2. *Fork-lift trucks.*

The fork-lift trucks in current use have an average capacity of 800 kg to 1 t. Most often they are fitted with electric motors (D.B., S.N.C.B. proposed, and S.N.C.F.) although the internal combustion engine still has its partisans (Denmark, Switzerland).

The electric elevator cannot in practice have such a high lifting speed as petrol driven trucks, but it is easy to drive and its operating costs (maintenance in particular) are lower than those of the truck with a thermal engine.

The table on next page shows the principal characteristics of the most widely used machines.

It is of particular value to have available fork-lift trucks adapted as far as possible to the characteristics of the rolling stock. The European loading gauge for example involves a maximum width of 2.60 m for covered wagons. The fork-lift trucks which have to work in covered wagons must therefore be able to turn in a sufficiently small space to enable them to work in the wagon. The height of the doors also limits the size of the fork-lift.

In the same way, the strength of the floors makes it necessary to reduce to the minimum the dead weight of such machines.

In this order of ideas, the German Federal Railways are satisfied with their 3 wheeled fork-lift trucks of reduced dimensions. The S.N.C.F. for its part uses two types of original equipment. One of these has a fork which can pivot 14 degrees around the vertical axis, which makes it possible to put the load in position without having to have the truck exactly at right angles to the site. The fork of the second model is of the classic type, but the arms of the fork are independent and pivot freely around the vertical axis thus facilitating clearing the truck after the load has been put down.

3. *Trailer trucks.*

The D.B. and S.N.C.F. use trailer trucks carrying two pallets, whilst the Swiss trucks can take 3, a solution which will also be adopted in the future in Denmark.

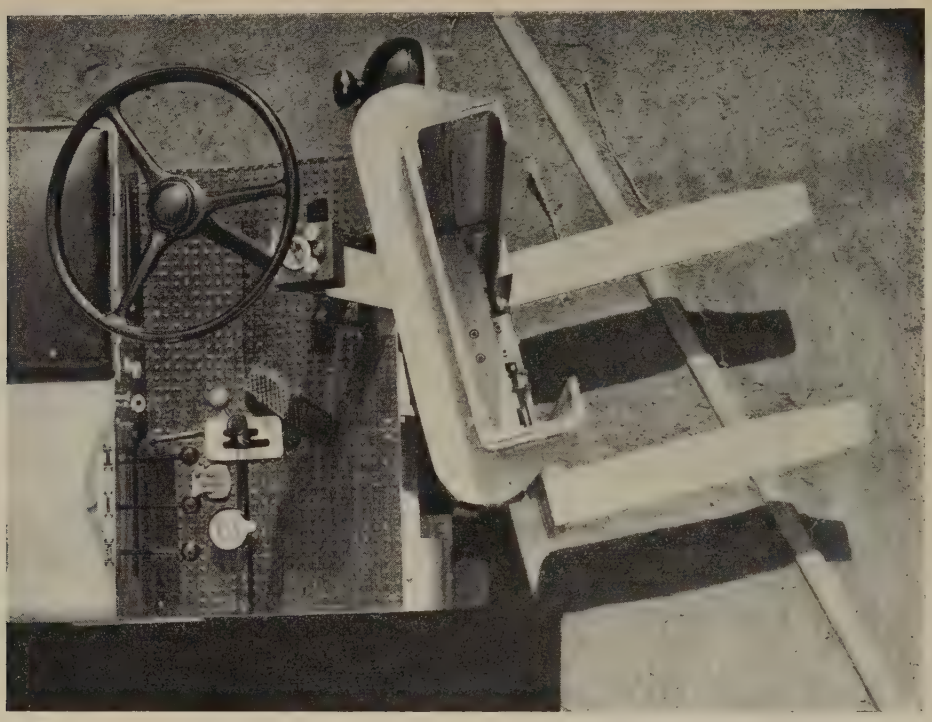
In centres using electric powered fork-lift trucks, which are relatively slow, the pallet trailers are hauled by special tractors, often with petrol engines (France for example). But when the fork-lift trucks are of the fast type and the amount of traffic to be carried on the trailers does not justify the exclusive use of a tractor, the fork-lift trucks are also used as tractors (in Switzerland, for example).

In this connection, mention must be made of a special installation in the Bale-Wolf Depot where the long distances to be covered make the use of a rake of trucks of particular value.

At each « key » point of the depot a « station » has been set up. This consists essentially of a section the width of the trucks, hollowed out in such a way that the floor of the truck running through it is at ground level. To facilitate the descent of the trucks into this pit, their wheels are guided by angles fixed permanently to the bottom of the pit. The pallet-carriers can thus easily be used for loading and unloading the pallets onto the trucks.

Principal characteristics of fork-lift trucks.

Administration	*Type of engine*	*Weight empty* kg	*Load* tons	*Can turn in* metres	*Speed on the level* km/h	*Wheels*	*Number of wheels*
Germany	electric	1 850	0.6		10	tyres	3
D.B	electric	2 050	1.0		10	tyres	3
Belgium	petrol	1 950	0.910	1.75	13	tyres	4
S.N.C.B.	(this type given up in favour of electric trucks)						
Denmark	petrol	1 950	0.910	1.65	13	pneumatic	4
D.S.B.	petrol	1 920	0.907	1.70	22	tyres	3
France	petrol	1 580	1.0	1.52	11	tyres	4
S.N.C.F.	electric	1 426	1.0	1.08	7	tyres	4
Hungaria	electric		0.8	1.27	5		
Luxemburg	electric		1.0	1.60			
Switzerland	petrol	1 950	0.910	1.65	13	pneumatic	4
	petrol	2 190	0.910	1.82	13.6	tyres	4



France. — Type of fork-lift truck with pivoting fork.

France. — Type of fork-lift truck with pivoting arm for the fork.

4. *Conditions of use of the machines.*

Pallet-hand-trucks are used when the traffic is not very great or when the distances to be covered are not very large. Most often such trucks are also used to handle any heavy loads which can be loaded from underneath. It is of interest therefore to develop the use of palletisable packings for all heavy or bulky goods, in order to avoid damage during their handling on the trolleys.

The fork-lift trucks are intended primarily to pile up and unload goods, and they make it possible to transport pallets and heavy parcels over average distances. Their use is combined with that of hauled trucks as soon as the distances increase, without the various users having explained the exact regulations in force. The various realisations in this connection are still too recent to be classified. Moreover local installations and conditions play an important part in determining the methods to be used.

Switzerland. — Pit for pallet carrying trucks. The platform of the truck is at platform level so that pallets can easily be put on the pallet-carrier.

It appears that in the case of pallets which are not stacked together, the unloading of the wagons takes place quicker if the pallets are taken out by means of pallet-carriers than by a fork-lift truck.

Moreover, the presence of non-palletized goods involves hand sorting, and the truck could very often get in the way of the sorters.

The pallet-carrier is then used for taking out the pallets and storing them for the time being near the wagon where they are picked up by the elevator trucks. However, if it is necessary to stack the pallets, the fork-lift truck must be used, hence the value of having elevators whose weight and manoeuvrability make it easy to take them into the wagon.

For loading, it is advisable to have this done directly by the fork-lift truck bringing up the pallets, unless the presence of other non-palletized parcels leads to difficulties.

5. *Output.*

The different Administrations have been using these various machines for too short a time for the output of the various types to be sufficiently accurately determined, in view of the co-existence of these new machines and the classic types of machines such as trolleys.

The following table gives the information collected :

Comparative costs for fork-lift trucks in proportion to the hourly wage of the driver.

	Germany (DB) 0.6 t electric tyres	*Denmark (DSB)* 1 t petrol	*France (SNCF)* 1 t electric, tyres	*France (SNCF)* 1 t petrol, tyres	*Switzerland (CFF)* 1 t petrol, tyres	*Switzerl. (CFF)* 1 t petr. with pneumat. tyres
Petrol or electricity . . .	0.065	0.111	0.20	0.25	0.121	0.10
Repairs - overhaul	0.300	0.369	0.20	0.55	0.502	0.495
Sinking fund interest . . .	0.250	0.350	0.40	0.30	0.413	0.817
Totals	0.615	0.830	0.80	1.10	1.036	1.412

16. Stacking pallets and box-pallets inside the wagons. Handling pallets in transit stations with low platforms.

A. Stacking pallets and box-pallets inside the wagons.

All the Administrations, who have developed transport by means of pallets and box-pallets to any considerable extent, stipulate that they must be stacked in the wagons in order to obtain a better user of the stock. The stacking of pallets may have given rise to some apprehensions regarding the behaviour of the parcels on the lowest pallet. Experience has shown that when the loading is properly done and the packing sufficient, such apprehensions are groundless. However, it is recommended to put the box-pallets at the bottom and the ordinary pallets on top.

Stacking, however, comes up against practical difficulties. First of all, it is only possible between depots equipped with fork-lift trucks unless one is prepared to unload the top layers of pallets parcel by parcel (D.B.). It cannot be system-

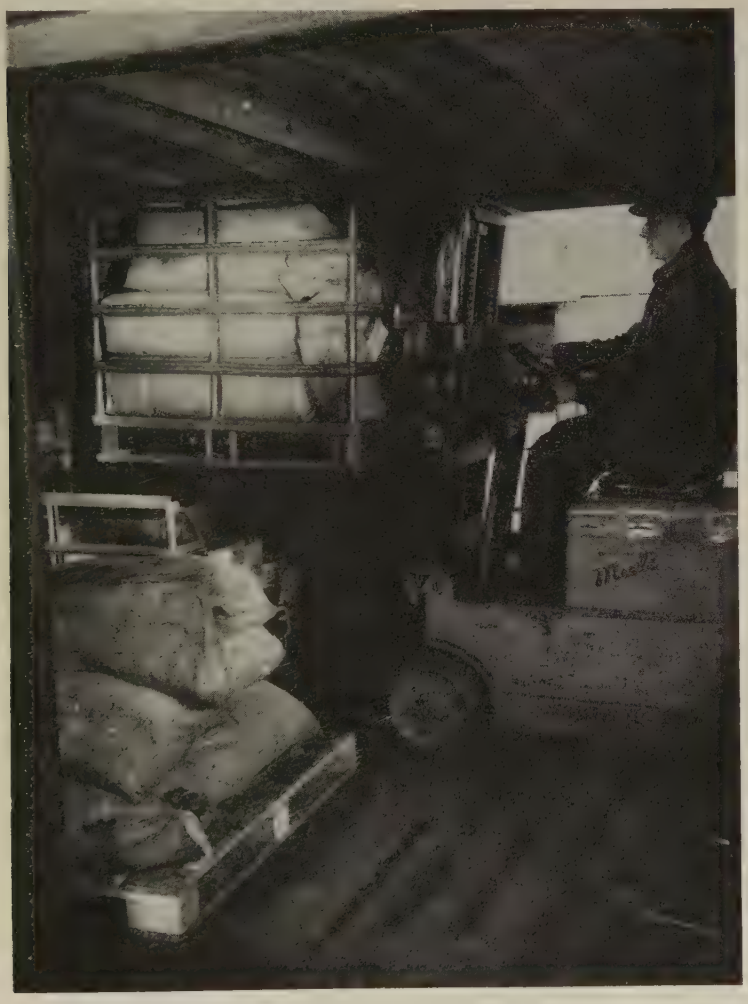
atically applied in every station : for this reason the D.B. and S.N.C.F. are studying designs for a low cost hand stacker-unloader.

It should also be pointed out that if there is a general tendency to stack, it is still far from being extensively practiced, as palletized traffic is not as yet fully developed.

B. **Handling the pallets in transit stations with low platforms.**

Stations served in transit only have a small amount of traffic. It has therefore often appeared of no value to palletize the traffic intended for such stations, in Hungary for example.

Such a position is bound to hinder the



Germany. — Stacking of box-pallets inside a wagon.

development of palletization, and in countries where it was accepted at the start of palletization, in Fracne in particular, it was given up as soon as the handling equipment was sufficient.

Moreover, in this case, to avoid over-equipment, the distributing trains usually carry a pallet-carrier with them.

The Administrations which accept palletised parcels for all stations use two different methods when the wagon cannot be put in a goods depot whilst the goods are being handled :

1) the palets stay on the wagon, the parcels being taken off them and delivered to the customer in bulk, in which case the railway loses the benefit of palletization at the terminal stage;

2) sometimes, the pallets are transhipped from the wagon to the depot by means of a truck. But, when it is a question of stations with low platforms, the differences in level between the truck and the wagon give rise to delicate problems.

It must be mentioned in this connection that the S.N.C.F. has successfully used 4 wheeled pole truck fitted with :

— a flat reinforced platform;
— some device to regulate the height of the floor so that it is at exactly the same level as the floor of the wagons;
— an articulated bridge fitted at the rear of the vehicle which assures a good connection with the wagon to be unloaded.

CHAPTER IV.

THE PROBLEMS INHERENT IN FACTORAGE.

17. Vehicles and equipment used for delivering parcels home.

In large towns, the vehicles used for picking up and delivering goods home are often specialised according to the nature of the traffic, sometimes taking into account traffic difficulties in large towns. Amongst others, mention may be made of the use of :

— three-wheeled vans for small parcels used in Denmark and certain zones in Paris;
— light vans for postal packages in various countries;
— ordinary lorries for parcels traffic (the type most frequently used);
— tractors and flat-trailers for heavy parcels, containers, and pallets.

Unloading and loading containers and pallets from ground level, when customers have no loading platforms, raises rather delicate problems.

The Administrations, moreover, recognise the fact that containers and box-pallets often remain on the lorries whilst being unloaded by the consignees, a solution which greatly hinders the hauliers by keeping their vehicle idle.

However, various solutions have been found, the most widely used of which are :

— the use of a small crane of swan neck formation at the back of the vehicle (France);
— the use of elevators (hayons élévateurs) (Belgium, Italy);
— use of low-loaders for transport (Germany, Switzerland).

18-20. Conditions under which parcels are transferred from the depot to the transport vehicles. Handing over of waybills — responsibility in case of loss or damage.

There is an obvious interdependence between the handling operations in the depot and the haulage, as a delay in one phase of the transport may possibly have repercussions on the other, in the case of both arrivals and consignments.

Variations in the arrivals, for example, will have an immediate effect upon the deliveries, the times of seasonal peaks causing the hauliers appreciable difficulties.

France. — Truck with rigging used to unload pallets where the platform is low. The height of the truck platform is regulated at each depot by means of the X shaped device in the front and V shaped device at the rear.

France. — Lifting gear used on vehicles delivering pallets, box-pallets and small containers.

Germany. — Trailer with low sliding platform for delivering small containers.

In the same way, a delay in the collection will affect the loading of the wagon owing to the rigidity of railway timetables. It is only in quite special cases (fish, for example) that the Administrations will agree to allow a slight delay in the departure times of the trains when there is a delay in bringing in the consignments, as any delay in the departures from the depots risks having a repercussion on the whole run for the wagons in question.

Sorting and loading parcels.

We have seen (question 12), how the parcels on being unloaded are put into

different bays and would remind you that various methods are used :

a) grouping the parcels according to the delivery zone with or without a geographical arrangement in order of the delivery services;

b) divided up according to the consignment numbers on the parcels;

c) the parcels are put in the bays without being sorted, but in such a way that it is easy to find them by the names on the numbered positions occupied by the parcels (palletized Swiss depots).

However, the haulier is always responsible for drawing up his rounds in his own best interest and that of the Railway, and in general, he loads his lorry himself (except on the S.N.C.B.), with limited help from the railway employees whose chief duty it is to make sure that the parcels do not stay too long in the depot and that there are no irregularities. It should, however, be noted that with method *c*), a depot hand has to work with the lorry driver in order to bring him the parcels from the general store in the order in which he wants to make his rounds.

Sorting and unloading collection lorries.

As a rule, there is no sorting of the parcels on the lorry by the collection services, unless the consignments are particularly urgent ones, which have to be specially treated in order to facilitate their handing over to the Railway. The unloading is done by the haulier, sometimes assisted by railway staff, to speed up the clearance of the lorries and sorting of the parcels (and their loading into the wagons).

Conveyance of waybills.

The load sheets, waybills and other documents are handed over to the lorry driver, in principle, in exchange for a carbon copy of the consignment note.

The handing over the documents usually is accompanied by a checking of the parcels. But to speed up the loading and departure of the delivery vehicles, this is sometimes passed over. This for example is the general practice on the S.N.C.F.

Responsibility in case of loss or damage.

In principe, the haulier is responsible for any loss or damage occurring to the goods after they have been accepted without any reserve until they are handed over to the Railway.

But various systems often limit the responsibility of the door to door services, in particular in case of hidden damage not perceptible at the time the parcel was handed over.

For this reason certain Administrations have preferred to give up the preliminary check, the responsibility for damage being divided up between the Railway and the haulier according to the rules in force on each Administration, the latter bearing the greater part of the cost of the damage.

It must be reported that on the D.B. official agents are obliged by the terms of their contract to insure themselves with an Insurance Company agreed by the Railway.

CHAPTER V.

PROBLEMS ARISING FROM THE GENERAL PALLETIZATION OF THE PARCELS TRAFFIC.

21. Present position of palletization.

If, compared with the summaries ennunciated at the Meeting of the Permanent Commission at Stockholm in 1952, an appreciable progress is noticeable in the field of palletization, only certain Administrations have reached the active phase of carrying it out, amongst which mention may be made of :

— Germany (D.B.);

— Finland (V.R.);

— France (S.N.C.F.);
— Switzerland (C.F.F. - B.L.S. - Rh. B.) and to a certain extent :
— Belgian Congo (Lower Congo to Katanga and Matadi-Leopoldville);
— Denmark (D.S.B.);
— Hungary (M.A.V.);
— Luxemburg (C.F.L.).

Other Administrations are studying the problem before going on to the phase of realisation in the near future. Amongst these we may mention :
— Austria (Ö.B.B.);
— Belgium (S.N.C.B.);
— Poland (P.K.P.);
— Czechoslovakia (C.S.D.).

The table hereafter shows for each Administration the present equipment of the depots in the stations or that to be provided in the near future.

22. Economic balance sheet for palletization.

The introduction of palletization in the transport of parcels is in most cases still too recent for the Administrations to have been able to draw up accurate balance sheets.

Only the Swiss Federal Railways, whose experience is the most complete and the most ancient, were able to draw up a balance sheet based on concrete operating results : it is very thorough-going and gives the profit on the capital invested as 15 %. It should be noted however that this balance sheet only takes into account the direct advantages of palletization on which it is possible to put a figure, such as savings in staff due to the speeding up in the handling; the C.F.F. only mention on the side the economies they have achieved when palletization has made it possible for them to avoid having to extend certain depots that had become too small, or the recuperations of traffic on other methods of transport for example.

The D.B. has not got out a general balance sheet like the C.F.F. They have merely prepared certain partial balances for given depots. These are all favourable. Taking into account, in the general plan, that it has been possible to avoid certain handling operations and certain damage to goods, without reducing the average load per wagon, the D.B. concludes that the general balance sheet is undoubtedly favourable.

The S.N.C.F. has prepared, a priori, an extremely cautious theoretical balance sheet, which has enabled it to conclude that palletization should be profitable on the whole, even if it only covers a small proportion of the parcels traffic, on condition, however, that it does not lead to a reduction in the average load per wagon. Experience since obtained is reassuring on this latter point — the average load has in fact tended to increase slightly — and the S.N.C.F. has calculated that with palletization limited to a mere 20 % of the tonnage consigned, the net saving will be of the order of 8 % of the direct handling costs for the whole of the parcels traffic. This assures an extremely high coefficient of profitability.

The Lower Congo-Katanga Railways, who have restricted palletization to handling in the depots, report that it makes possible an appreciable increase in the storage capacity of the depots, which it is possible to evaluate at 75 %. This is an advantage which is not without value, particularly in the case of arrival areas.

The Czechoslovakian Railways point out that the effects of palletization must not be judged solely on the balance sheet of the transport undertaking but within the framework of the general economy of the whole country.

In general, the Administrations, who have some experienceof palletization, are agreed that in addition to the direct economic value which guarantees a high return from the capital invested, the use of pallets results in :

Equipment for use with palletization.

	Type I I.R.U. (U.I.C.) (800 × 1 200)			Type II I.R.U. (U.I.C.) (1 000 × 1 200)		Other types		Pallet-carriers	Elevator trucks
	Pallets	Box-pallet (open type)	Box-pallet (closed type)	Pallets	Box-pallet (open type)	Pallets	Box-pallet		
Germany (DB)	—	—	—	66 000	62 000	—	—	3 678	373
Lower Congo-Katanga	—	—	—	—	—	10 000	200	—	—
Belgium (SNCB)	7 500(1)	—	—	—	—	—	—	149 (1)	17 (1)
Denmark (DSB)	7 500	85	—	—	—	—	—	183	32
	3 500(1)	1 300 (1)	—	—	—	—	—	10 (1)	10 (1)
Finland (VR)	—	—	—	75 000	5 000	—	—	450	100
France (SNCF)	90 000	30 000	13 000	—	—	—	—	2 500	250
	60 000(1)	10 000 (1)	4 000 (1)	—	—	—	—	—	—
Hungary (MAV)	2 800	—	—	—	—	—	—	52	22
Luxemburg (CFL)	—	—	—	—	14	—	—	2	—
OTRACO-C.F.M.L.	—	—	—	—	—	700	—	—	6
Switzerland (CFF)	150 000	12 200 (2)	1 700	—	—	—	—	1 700	170
Switzerland (Rh.B.)	350	—	—	—	—	—	—	—	—

(1) on order. — (2) raised up.

— an appreciable reduction in damage during transport, whilst enabling customers to use lighter types of packings;

— an appreciable reduction in fatigue for the staff;

— a net reinforcement of the commercial position of the railway particularly when it is in a position to offer its customers common user of pallets or box-pallets of a standard type;

— in increase in transport potential of the railway, owing in particular to the improvement in the capacity of the fixed installations, the appreciable speeding up of handling operations and door to door deliveries.

23. Evaluation of the palletisable traffic. - Influence of the standardisation of packings.

A distinction must be made between two sorts of palletization : that which, starting from the consigning station (or better still the private premises) carries the parcel on a pallet right up to the destination station (or again preferably right to the customer's shop), and that which constitutes merely a method used for handling in the depots.

The information supplied by the different Administrations in most cases makes no distinction between these two forms of palletization. This is why there is seen to be such wide divergences of opinion in the estimate of the traffic that can be palletized.

For example, the German Federal Railways estimate that the palletizable traffic amounts to 60 % or even 70 % if that carried in small containers is taken into account, which could be carried in box-pallets.

The Swiss Federal Railways put it at 70 %.

During a preliminary theoretical study, the S.N.C.F. started with a figure of 30 %, but if this figure is not yet reached, they think it could nevertheless be reasonably expected that it will be reached and even exceeded, this figure of 30 % only representing the traffic palletized during transport, and not storage and transfers in the depots. As regards handling on pallets carried out in the depots, the percentage of parcels that can be dealt with in this way is obviously much greater, and the Belgian Colonial Railways (O.T.R.A.C.O.-C.F.M.L. and Lower Congo to Katanga Railways) state for example that 95 % of the parcels traffic is palletized in their depots, the pallets not being used for the transport of the goods in the wagons.

One of the obstacles to the development and complete success of palletization is the heterogeneity of the parcels, many of which are not packed, as well as the heterogeneity of the packings themselves. National organisations are trying to standardise the latter, and the Railways are following with interest the efforts made in this direction. They are often taking part in the work of standardization.

Mention must be made in this connection of :

— the D.B. and the Packing Standardisation Committees;

— the S.N.C.B. and the Belgian Packing Institute;

— the D.S.B., the Danish Standardisation Council and the Danish Packing Institute;

— the C.F.F. and the S.S.R.G. (Swiss Society for the Rationalisation of Handling);

— the S.N.C.F., the General Packing Laboratory and the French Standardisation Association.

But it is difficult to say up to what point this common action of specialised organisations and the Railways has had any positive result, apart from a few special cases such as the adoption in Switzerland of 50 kg paper sacks for the transport of sugar and the modification of the cartons used by a large Detergent Firm.

Persevering efforts will no doubt be required to obtain any notable improvement in the position in this connection.

24. Dimensions and constructional specifications of pallets.

The pallets mainly used by the Administrations covered by our questionnaire are 800 × 1 200 and 1 000 × 1 200 :

— *800 × 1 200* = Austria (Ö.B.B. proposal), Belgium (S.N.C.B.), France (S.N.C.F.), Hungary (M. A. V.), Czechoslovakia (C.S.D.), countries to which may be added those which have adopted the 810 × 1 215 pallet, a slight variation of the former : Denmark (D.S.B.) and Switzerland ([1]) (C.F.F., B.L.S., Rh.B.);

— *1 000 × 1 200* = Federal Germany (D.B.), Finland (V.R.).

The Administrations who have adopted the 800 × 1 200 type (or its 810 × 1 215 variation) find that it has the following advantages which are not shared by the 1 000 × 1 200 type :

1) the area of the wagons is better used. In fact the length of a load of pallets over a width of 2.40 m (twice 1.20 m or 3 times 0.80 m) increases by 400 mm in 400 mm with the 800 × 1 200 pallets and 1 000 mm in 1 000 mm with the 1 000 × 1 200 pallets (see on the above drawing an example of the loading of a « I.R.U. (U.I.C.) type 2 » wagon with these two types of pallets);

2) the weight and the power of the elevator equipment can be reduced (centre of gravity of the load 400 mm from the end of the forks with the 800 × 1 200 pallet instead of 500 mm with the 1 000 × 1 200 pallet);

3) the tare of the pallet can be limited to about 25 kg which makes it easy to put it in place when empty by hand.

([1]) Switzerland also uses to a limited extent 600 × 810 and 1 010 × 1 215 pallets, which however do not share in all the concessions granted to 810 × 1 215 pallets.

The various countries are following different policies for the construction of pallets. Though wood is used everywhere, it must be mentioned that the specifications are more or less strict according to whether a robust pallet is wanted (Germany, Finland, France, Hungary) or a cheaper pallet with a shorter life (Belgium, Denmark, Switzerland). For example, the S.N.C.F. stipulate the use of hardwood for the side timbers which take the shock of the forks of the handling machines. The D.B. even provides for the strengthening of the upper deck by a framework with metal angles.

However, even in the case of the cheaper pallets, the design has been the subject of studies and trials which have led, for example, to the almost general use of twisted nails which give very strong assemblies.

The most frequent damage is to the side timbers and angle pieces, exposed to the shock of the forks. It is difficult to remedy this, and only careful education of the staff using the lifting machines can reduce such damage.

In general, the annual repair costs amount to 2 to 5 % of the purchase price.

25. Dimensions and constructional specification of box-pallets.

It is not possible to use simple pallets for some types of goods, owing to their shape or fragile nature. For this reason, different Administrations also use box-pallets.

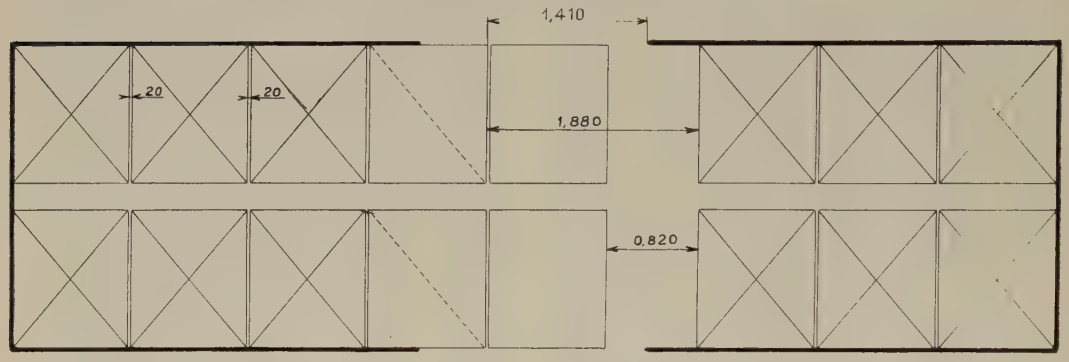
The box-pallet is essentially a box on legs whose dimensions and position make it possible to pick it up with the proper handling gear (elevator-trucks and pallet-carriers) and stack it with other box-pallets of the same type or even with other pallets of the same size.

The container may consist of 3 or 4 removable or non-removable sides, and be fitted or not with a cover.

The Railways who stipulate stacking in

Example of loading I.R.U. (U.I.C.) type 2 wagon with 1 000 × 1 200 box-pallets with the maximum tolerance of 1 040 × 1 240 mm.

Pallets that are not stacked: 16 pallets, i.e. useful area of 19.2 m²
Stacked pallets: 30 pallets, i.e. useful area of 36 m².

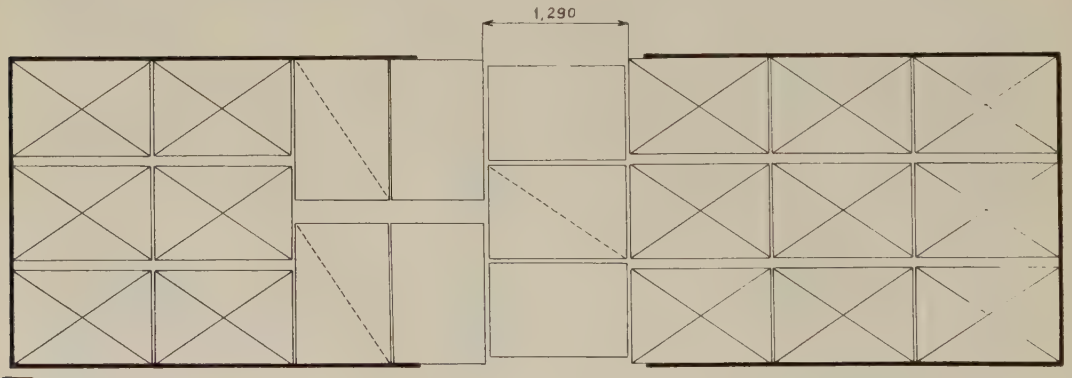


palettes gerbées
palettes non gerbées
possibilité de gerbage dans certaines circonstances

Longueur utile : 9,260 m
Largeur utile : 2,700 m
Largeur des portes : 2,000 m

Example of loading I.R.U. (U.I.C.) type 2 wagon with 800 × 1 200 box-pallets with maximum tolerance of 835 × 1 240 mm.

Pallets that are not stacked: 22 pallets, i.e. useful area of 21.12 m².
Stacked pallets: 41 pallets, i.e. useful area of 38.40 m².



palettes gerbées
palettes non gerbées
possibilité de gerbage dans certaines circonstances

Longueur utile : 9,260 m
Largeur utile : 2,700 m
Largeur des portes : 2,000 m

N. B. — Palettes gerbées = stacked pallets. — Palettes non gerbées = pallets that are not stacked. — Possibilité de gerbage dans certaines circonstances = possibility of stacking under certain circumstances. — Longueur utile : 9.260 m = useful length : 9.260 m. — Largeur utile : 2.700 m = useful width : 2.700 m. — Largeur des portes : 2.000 m = width of doors : 2.000 m.

the wagons to get good user of the available volume of space (for example : Germany, France) fit their box-pallets with angles on top of the upper edges to prevent sliding when the pallets are stacked one on top of the other. On the other hand, those Administrations which do not go in for systematic and intensive stacking of the pallets in the wagons have not thought it necessary to fit their box-pallets with special devices to facilitate stacking (Switzerland for example).

There are in general two main types of box-pallets, for different purposes, one without a cover and one completely enclosed.

Open box-pallet.

The sides consist of a metal trellis, of iron strips or wire, of varying-sized mesh. In general, the side walls have a V shaped opening to facilitate putting the parcels inside them. The D.B. also uses a box-pallet one side of which can be removed, the upper half being flanged. These latter types of box-pallet, more fragile and more expensive than the previous ones, have the advantage of protecting uniformly the whole lot of parcels during the journey, whereas those with a V opening leave a certain area unprotected.

A comparison must be made between the open box-pallets and the wooden trays used in Switzerland and under study in Denmark. These standardised trays make possible various combinations of stacking trays one above the other according to the type of goods being carried. They take up less space when empty than the fixed box-pallets, but they are very fragile.

The open box-pallets are more particularly intended for grouping packed parcels whose dimensions, shape or fragility make them unsuitable for palletization on ordinary pallets.

Closed box-pallets.

The closed-in box-pallets, made of metal (France) or wood (Switzerland) are almost exclusively used to replace small containers, as like these, it makes possible considerable economies in the packing of goods, whilst avoiding saddling the recipient with rolling gear which is heavy, costly and frequently gets damaged. The purchase price of box-pallets of this type is much lower than that of containers but still too high to allow of their intensive use in commercial or industrial stores in order to store goods.

The open or closed box-pallets in use most often comply with the following data :

a) the exterior dimensions remain within the maximum dimensions laid down by the I.R.U. (U.I.C.) : 835 × 1 240 or 1 040 × 1 240;

b) the useful interior dimensions are whenever possible the same as those of the 800 × 1 200 or 1 000 × 1 200 pallets, so that the standardised packings can be used with both pallets and box-pallets.

The D.B. and S.N.C.F. prefer to use rigid box-pallets rather than collapsible ones for the following reasons :

1) collapsible box-pallets are more fragile and more costly to maintain, owing to the weak points constituted by the joints in the walls;

2) the time spent in folding and unfolding the walls is considerable and must be deducted from the saving in handling times;

3) the value to the railway of being able to fold up empties becomes of no account when palletization is generalised to such an extent that empty journeys are rare;

4) in the case of the 800 × 1 200 pallets, folding up tends to limit the height of the walls and consequently all the useful height of the wagon is not made use of when two box-pallets are stacked on top of each other.

On the other hand, the Finnish Railways

Characteristics of pallets.

	Side timbers	*Inter-mediate boards*	*Studs*	*Method of assembly*	*Special features*
Germany (DB)	hardwood	softwood	hardwood	bolts	reinforced with metal angles
Belgium (SNCB)	softwood	softwood	softwood	twisted spikes	
Denmark (DSB)	softwood	softwood	softwood	twisted spikes and ordinary spikes	
France (SNCF)	hardwood	softwood	softwood	twisted spikes and ordinary spikes	
Switzerland (CFF, Rh.B, BLS) . . .	softwood	softwood	softwood	twisted spikes and ordinary spikes	

who have some experience of both types of box-pallets, prefer the collapsible type with very fine mesh sides, which is very much liked by the public.

26. Modifications made to the depots in view of palletization.

The depots were not designed for this type of handling when palletization was introduced.

For this reason, modifications have had to be made, mainly affecting three principal points :

1) *Nature and strength of the platforms.*

Certain Administrations had to improve the floors of the depots to facilitate the running of the pallet-carriers whose rollers are small in diameter and do not like differences in level. The C.F.F. have made remarkable efforts in this connection : investigations were undertaken to find a smooth non-slippery, dust-free flooring. Various solutions were retained, amongst them a hard asphalt covering on a concrete base, and removable paving stones of a special composition, on a base of sand.

The need to reinforce the strength of the floors was apparent above all in the depots where motor fork lift trucks were put into service.

2) *Height of the platforms.*

Although handling on the same level is always of undoubted value in the case of parcels handled by hand, it becomes practically essential when considerable loads have to be handled. With pallets, therefore, as far as possible any difference in level between the platforms of the depot and the vehicles must be done away with.

On the siding side, the only possible solution is to adapt the level of the platforms to that of the wagons. All the Administrations concerned report the alterations made to their depots to adapt them in this way, either by altering the platform itself, or by raising up or lowering the tracks.

On the yard side, the lorries have much greater differences in level than the wagons, so that the problem is very much greater. It should also be noted that the level of the lorry floor varies a lot during loading or unloading owing to the compression of the suspension springs and the tyres. Mobile bridges of some length have to be used, the putting into position of which is tiresome for the working, or even hydraulic or electric mobile bridges, which is an expensive solution that lacks flexibility (see question 7).

3) *Obstacles in the way of free movement.*

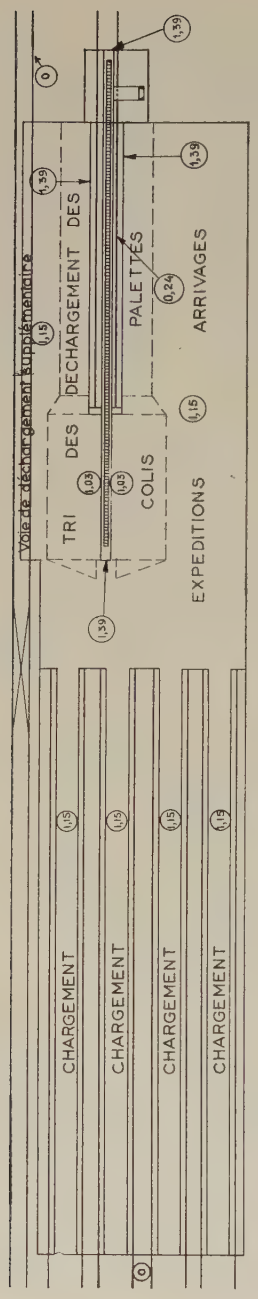
The movement of motors within the depot requires rectangular alleyways, without any obstacles and well signalled. This is fairly easy when new depots are to be built, where particular attention can be given to the siting of the pillars and partitions, but the removal of such obstacles in the old depots involves such costly alterations that it can rarely be undertaken.

Thus, to obtain the best output from general palletization, the goods depots must meet the following principles :

— sufficient area of the platforms without obstacles to allow the motor or other equipment to move about freely;
— platforms at exactly the same level as the floor of the wagons, and practical connections with the lorries;
— a strong floor kept in an excellent state of repair.

The S.N.C.F. report that mechanised depots without platforms were designed before the introduction of palletization and certain difficulties have been experienced, especially as regards the stacking of the pallets in the wagons on departure.

If no adequate handling equipment can be designed, and if palletization reaches the expected development, future installations must be based on rather different



① Cotes au-dessus du niveau des rails des voies de chargement

Depot with platforms served by conveyor belt. (**S.N.C.F.**: St. Pierre-des-Corps).

N. B. — Chargement = loading. — Tri des colis = sorting of parcels. — Expéditions = consignments. — Arrivages = arrivals. — Déchargement des palettes = unloading of pallets. — Voie de déchargement supplémentaire = supplementary unloading siding. — Cotes au-dessus du niveau des rails des voies de chargement = height above rail level of the loading sidings.

principles, for example by adding narrow platforms to such depots solely for the use of the elevators.

In any case, it appears desirable to retain the conveyor belts intended for the preliminary sorting of non-palletized parcels; the S.N.C.F. are going to build at St. Pierre-des-Corps a depot designed on these lines, with a conveyor belt for sorting, and with platforms intended for running all types of machines : tractors and trailer-trucks, pallet-carriers, elevator trucks (see drawing on the left).

27. Influence of palletization on the characteristics of wagons and road vehicles.

The characteristics of European rolling stock now in service make it possible to use pallets in a standard fashion. But certain difficulties have occurred due essentially to the type of floors, the width and height of the doors and the useful length of the vehicles.

Obviously it is much easier to handle pallets in large wagons with wide, high doors and smooth floors. This is one of the reasons why the future European covered wagons will have 2 m wide doors. It is desirable to make the doors rather wider than 2 m to make it possible to get into the wagon with two stacked pallets and thus do away with the need for stacking them inside the wagon. The current dimensions of European wagons make it difficult to load them up completely with rider controlled fork lift trucks.

Usually, the last pallets to be loaded into the wagon cannot be put in by the elevator truck which no longer has sufficient room to manoeuvre. These pallets therefore have to be put into position by hand with pallet-carriers.

Not much improvement can be hoped for in this connection owing to the gauge. Mention should however be made of trials of a wagon prototype in Germany. This type of wagon can be loaded completely

Germany. — Loading of box-pallets in a wagon with sliding side-walls.

with elevator trucks without the latter having to perform dfficult manoeuvres inside the wagon.

The road vehicles, much more diverse than the railway rolling stock, will no doubt undergo an evolution in the future from the double point of view of the strength of the floors, which is often insufficient, and standardisation of the height above ground.

It must be mentioned that one of the difficulties in the way of the extension of palletization is due to the frequent lack of loading facilities at client's premises. The factories and stores are built at ground level and the use of pallets for

transport causes a lot of trouble. This is sometimes overcome to some extent by installing fixed ramps or elevator platforms. But it must be remembered, as stated in question 17, that the lorry services can make use of various devices to facilitate the handling of pallets and containers : small cranes at the back of the vehicle, elevators (hayons élévateurs); low loaders, etc.

28. Influence of palletization on the average wagon load. - Concentration of traffic due to palletization.

The influence of palletization on the average wagon load is a controversial point at the present time.

The facts are not known. This is due to three reasons :

— palletization is of too recent introduction;

— it has not yet reached a sufficiently generalised stage on most Administrations;

— the average load considered satisfactory varies considerably according to operating conditions on the different railways.

The Swiss Federal Railways have the longest experience of this technique and think that its effects were unfavourable to begin with, but as it became generalised, palletization has made possible an improvement in the degree of user of the stock.

The Finnish Railways note an appreciable improvement.

On the S.N.C.F., where palletization is still in its initial stages, the average load has not been affected by this new technique to any appreciable extent, but it is thought that having regard to the long runs that can be made, palletization will constitute a success provided the average loads of the through parcels wagons are not reduced; this is the reason why such importance is attached to the stacking of pallets inside the wagons.

The Hungarian State Railways, whose experience is very recent, have not noticed any change.

On the other hand, the Czechoslovakian Railways think that they are getting a poorer use of the volume and load per wagon, through being unable to stack systematically in the wagons.

The average load of the parcels wagons on the D.B. in transhipment centres has remained unchanged for three years. But it is difficult to draw any conclusion from this statement because parallel with the introduction of palletization, modifications were made in the structure of the parcels traffic. The D.B. also state that the parcels have got lighter and bulkier; the « good » parcels have to a great extent switched over to other types or other methods of transport.

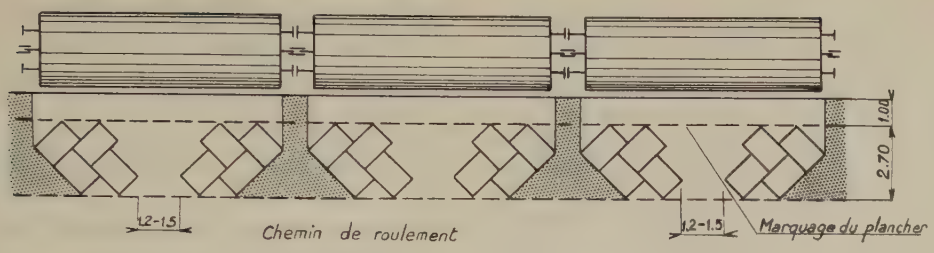
The Administrations do not appear to have evolved a sufficiently foolproof palletization technique to consider modifying their forwarding arrangements for parcels. It does not appear that the saving made both in cost and time in transhipment operations as a result of palletization has led the Administrations to modify their routing programmes.

29. Influence of palletization on the organisation of work in the stations.

Most Administrations consider that palletization involves a considerable modification in the organisation of the work in the different areas of the depot. The D.B. makes it clear that these effects are considerable and the C.F.F. add that only a methodical reorganisation of the work will make it possible to obtain the hoped for results from palletization.

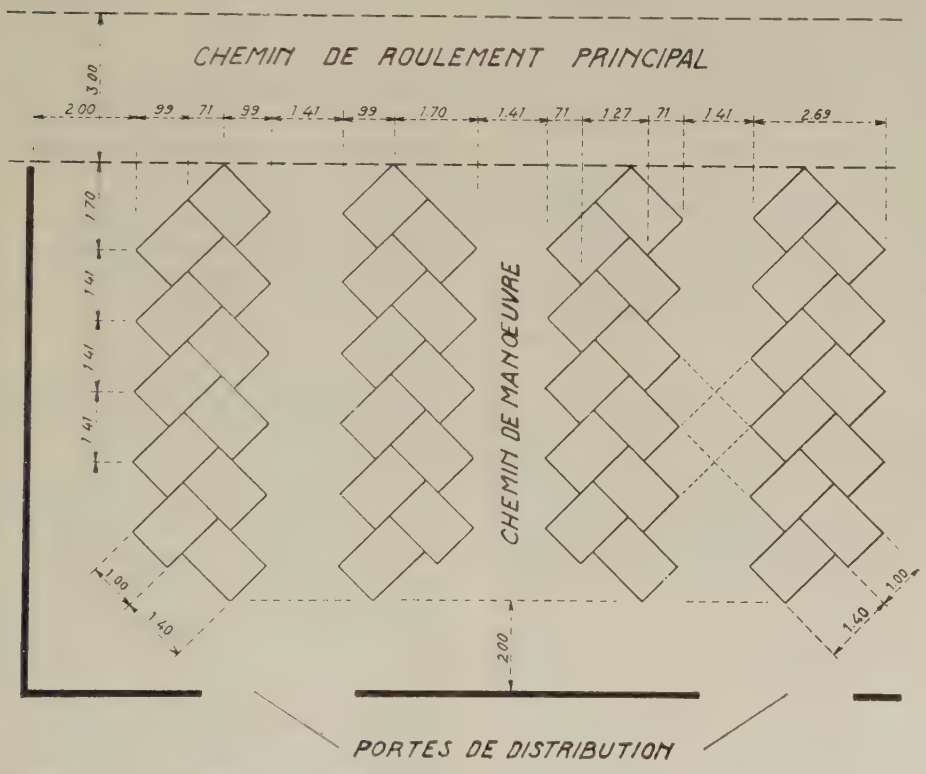
On the other hand, the Czechoslovakian Railways consider that this influence is very slight when palletization replaces other methods of mechanisation.

It is obviously desirable that palletization should be used by the consignors themselves; but as this is still rarely the case, the Railways in order to obtain all the



Emplacement des chariots destinés à recevoir les colis non palettisables

Switzerland. — Arrangement facilitating making up pallets when unloading the wagons.



Switzerland. — Example of arrangement of 800 × 1 200 mm pallets in saw tooth formation in arrival area, where they are stowed by fork lift truck.

N. B. — Chemin de roulement = trolleying path. — Marquage du plancher = marked out floor. — Emplacement des chariots destinés à recevoir les colis non palettisables = site of trucks on which non-palletized parcels will be loaded. — Chemin de roulement principal = main trolleying path. — Chemin de manœuvre = manoeuvring path. — Portes de distribution = distribution doors.

advantages of general palletization must themselves provide pallets for transport.

The consigning areas must therefore be organised in such a way as to make the maximum possible use of pallets, particularly for grouping the small consignments. With this object in view, certain Administrations (D.B., C.F.F., S.N.C.F.) stipulate that an allocation of pallets is to be placed either in the consigning area itself or in the sorting area, on which the parcels are put as received or sorted.

At the arrival area, the pallets of miscellaneous parcels for the locality, are taken as far as possible in the handling cycle before the parcels are sorted into the delivery areas; certain Administrations even make up pallets with the parcels that come in non-palletized; this is the case in particular on the D.B., C.F.F. and Lower Congo to Katanga.

In general, the Administrations stress that palletization makes it possible for them to speed up and facilitate their handling operations, to cope more easily with peak traffics, to obtain considerable savings in labour costs, and to get work of a better quality.

Thus certain Administrations are completing the palletization of their depots by using pallets for internal handling operations in the depot. The C.F.F. have made this obligatory. The D.B. mentions that it intends to apply this measure gradually so as to obtain more profit from the equipment used. The S.N.C.F. is making various trials in this connection.

30. The making up of pallets by the stations.

Three kinds of pallets are made up by the stations :

a) Pallets loaded with parcels for a single destination when the consignment is sufficient for a reasonable use of the capacity;

b) pallets loaded with parcels for a single destination station;

c) pallets loaded with parcels for a transhipment centre.

In general the Administration endeavour :

— to get the consignors to make up the pallets under *a*);

— to get the maximum number of pallets under *b*) made up in the consigning areas;

— only to make up pallets under *c*) when necessary, if needs be according to a programme prepared in advance by the Management.

The Administrations put special labels on all categories of pallets (D.B., Luxemburg, S.N.C.F.) or only on certain ones (C.F.F.).

These groupings of parcels are made either on simple pallets (all Administrations) or on pallets with raised up sides (C.F.F.) or box-pallets (D.B., Finland, Luxemburg, S.N.C.F.).

The proportion of the different types used varies considerably from one Administration to another.

It is 10 to 1 in favour of simple pallets on the C.F.F., 1 to 6 in the Luxemburg plan, about 1 to 1 on the D.B. and S.N.C.F. These differences may be due to several causes, the chief of which appear to be that on the D.B. and S.N.C.F. palletization is still only a recent introduction and the mileages for which it is used are relatively long; it is also due to the fact that on the C.F.F. stacking is very little practiced; finally, in different countries the proportion of small parcels is not constant, and when there are a lot of small parcels, they are naturally put into box-pallets to reduce the risk of loss and damage.

31. Difficulties encountered in the transport of pallets.

The Administrations all report in varying degrees difficulties due to obtaining stability of the parcels on the pallets (sliding, instability and loads getting upset). They have taken steps to remedy these difficulties and in most cases consider that they have solved the problem.

However, the characteristics of the traffic and actual working conditions on each Administration are likely to result in a considerable variation in the kind and amount of difficulty encountered. It is therefore necessary to take into account :

— the conditions of the goods to be palletized;
— the type of packing (bonded, stuck together, adhesive band, etc.). Palletization by the customers often fulfils these conditions;
— the need to respect the limitations imposed by stacking pallets or box-pallets together;
— the experience of the staff, i.e. how long palletization has been used.

Making up the pallets.

In general the Administrations consider that the parcels should be grouped together into a homogeneous block and staggered criss-cross to bind them together. When this is done the load is stable and does not become dislodged during transport.

The C.F.F. state that since such precautions have been taken the difficulties have gradually disappeared in spite of very extensive palletization, which includes the use of a very large proportion of simple pallets.

The D.B. and S.N.C.F. on the other hand make considerable use of the box-pallets, especially for light, small or fragile parcels.

The Danish Railways are also tending towards using box-pallets or pallets with high sides.

The Hungarian and Finnish Railways consider it is often necessary to bind the goods to the pallet with a tie.

Siting the pallets in the wagon.

In principle, simple loaded pallets should be pushed into place; the S.N.C.F. state that they should be fitted in between the sides of the wagon and other goods, preferably box-pallets.

The C.F.F. arrange protective panels between the stacks of pallets if these are likely to get out of place.

Several Administrations, in particular the D.B. consider that large centres which send out several wagon loads of parcels daily to the same destination should as far as possible make up some wagons entirely with pallets; they consider that when such a solution is not possible, the pallets should be placed and stacked on one side of the wagon, and the non-palletized goods on the other.

32. Drawbacks resulting for the co-existence of palletized and non-palletized goods.

In general, the Administrations consider that there have not been any special difficulties on the platforms. Use is made according to the case either of the usual handling gear (trolleys, trucks, etc...) or elevator-trucks or pallet-carriers.

The D.B. and S.N.C.F. state quite definitely that no drawback results from these two different transport chains being worked at the same time.

Certain Administrations (C.F.F.) limit the classic type of handling to those parcels whose exceptional size or weight makes it impossible to load onto a pallet. In the arrival areas, certain special sites are usually reserved for such parcels.

In wagons for a transhipment centre, it is recommended not to place other goods on the load of pallets unless it is quite easy to see that such goods are not part of the pallet load (for example : wrapped parcels of great length).

In the wagon, taking into account the technical precautions mentioned under the

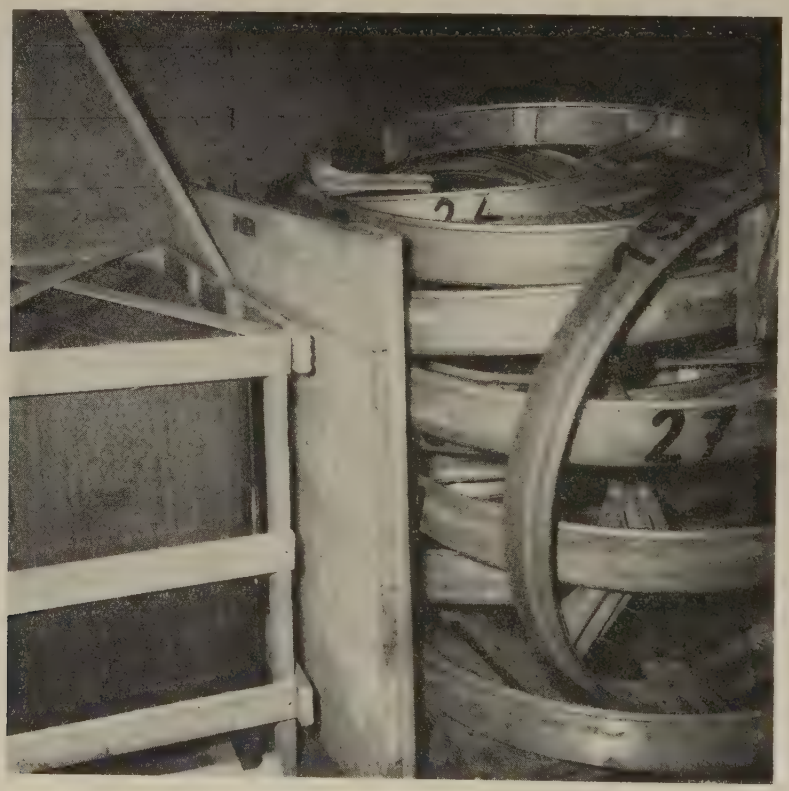
previous question, the co-existence of non-palletized and palletized parcels is not a major obstacle to palletization, but several Administrations mention certain difficulties which they are endeavouring to solve.

For example the D.B. and the S.N.C.F. state that if it is not possible to reserve certain positions for the pallets (special wagons or half wagons) the presence of non-palletised goods impedes the work of the elevator trucks and stowing of the pallets in the wagon.

On unloading the D.B. and S.N.C.F. also report certain difficulties in identifying parcels and parcels may get mixed up and some of them go astray.

The C.F.F. on the other hand state that they encountered the same difficulties to start with when palletization was introduced, but the staff is now sufficiently experienced to overcome them.

Finally, in general, it has not been reported that the co-existence of the two types leads to any loss of space in the wagons.



Switzerland. — Use of a packing panel inside a wagon to keep parcels in place.

33. Distribution of empty pallets and box-pallets. - Amount of empty runs.

Movements of empty pallets must be reduced to the minimum essential for a profitable service. It is therefore essential

to re-use on site every pallet that comes in loaded; as this does always with all empty runs. Experience shows, however, that the traffic is not always balanced, in fact, as certain districts receive more consignments than they send out and vice versa. It is therefore necessary to distribute the pallets between areas where there are too many (after all needs have been satisfied) and those where there are too few.

Distribution usually takes place as follows :

The stations advise an allocation organisation each day of the numbers they hold and the numbers they need. This organisation which therefore knows the position at all the stations in its area, issues orders for the distribution of the pallets. If necessary, a central office deals with allocations between areas. This somewhat cumbersome method has however the merit of adapting resources to needs as accurately as possible. It is in use in France for example.

On the D.B., distribution is largely left to the transhipment centres in the case of the area covered by their collecting and distribution services. The depots tell the transhipment centre to which they belong how many pallets they need or hold in excess of requirements when this is necessary. If needs be, the centres get in touch with the Regional Managements. In addition, depots which regularly have too many pallets send them on to the depots which always have too few, without making any special announcement of the fact.

The S.N.C.B. is considering adopting a very similar method. A general plan will show the number of pallets to be used on the average each day by each depot. At midday, each establishment should have in hand a sufficient number of pallets in good condition to meet two days requirements, and they will only get in touch with their centre station if their stock is insufficient. Pallets in excess of the fixed average number will be automatically sent to the centre station as soon as they amount to more than three days supply. Distribution will only take place at a central stage between the centre-stations and the general reserves.

With these last two methods, the intervention of the allocating organisation is reduced to the minimum. Moreover, the average figure for pallets provided for each establishment can quickly be modified if circumstances require.

It would appear that it is always advisable to make use of a simple method which needs no complicated accounts, often a source of mistakes. But, if a general plan is drawn up, it must be left sufficiently flexible for it to be adapted to local circumstances.

Moreover, the experience of countries where palletization has reached a certain development shows that distribution and the need for empty runs will fall off as palletization develops, and that in many cases pallets travelling as empties are used to wedge up the loads, so are not quite useless.

Nevertheless, certain traffic in returned empties plays quite an important part in the parcels traffic. When the state of unbalance is greater, it becomes necessary to use complete wagons of pallets, and this is a source of expenditure which it is very desirable to avoid.

The C.F.F. for example state that they have practically no traffic in empty pallets, and what there is is limited to traffic between small depots and neighbouring transhipment centres which act as the grouping stations for them. Between these transhipment centres the traffic is more or less balanced.

The D.B. found that during the initial phase, when not all the establishments were using pallets, and only 7 % of the slow parcels traffic was palletized, the ratio between loaded and empty pallets was still 5 to 1. During the extension of the

method to all the establishments, and to 26 % of the parcels traffic, they have cut this down to 13 loaded pallets for each empty pallet.

All the above relates to simple pallets and box-pallets (or with raised up sides), but it is not at all the same when closed type box-pallets are considered, for two reasons. These apparatus, of high cost, are limited in number and their only users (or almost) are private firms or establishments with special needs (customs stations for example). It is therefore necessary to allocate them very carefully and this means a much stricter distribution in order to avoid profitless empty runs and costly immobilisation of the capital invested.

34. Repercussions on international transport.

To date palletization has not had any appreciable repercussions on international transports. Certain Administrations merely mention certain agreements made in special cases for certain given traffic or the use of closed box-pallets for transport with the customs seal.

On the other hand, the Administrations think that palletization is advisable for international transports, and state that pools should be set up between the railway Administrations.

The I.R.U. (U.I.C.) has actively gone into this question and recently published a text for a typical agreement for the common user of pallets between Administrations who wish to facilitate the use of pallets in international traffic.

However, in order to make such agreements, it is necessary for the types in service to be of identical constructions, both as regards dimensions and constructional details.

Certain Administrations (D.B., C.F.F., Luxemburg, S.N.C.F.) wish that some solution could be arrived at in this field, particularly in the case of simple pallets.

In this connection the action of the European Conference of Ministers of Transport and the International Chamber of Commerce should be noted, who are making efforts to recommend the adoption of a single type of pallet on the international plane in order to facilitate the development of « pools ».

35. Attitude of the staff towards palletization.

a) Employees are cautious about the introduction of any new technique which upsets their life long habits. When in addition, such a technique makes it possible to cut down on numbers, the men are still less likely to welcome it. But very soon they change their ideas when they see that their work becomes easier and less tiring. This evolution is that reported by the Administrations who have had some experience of palletization. As its introduction generally coincided with an increase in the traffic, the reduction in staff was very small, which made it easier for them to adapt themselves.

In any case, it is necessary to make the foremen of the depots concerned understand the value of palletization for the whole organisation of the transport; when a small depot makes up a pallet they have to devote care and time to doing so, without reaping any great advantage, as the benefit is felt above all by the depots which will subsequently handle this pallet.

Switzerland and the D.B. therefore insist upon the need for making use of gangs of specialists who will be responsible for explaining the value of the method and instructing and training the staff in its use.

b) All the Administrations have instituted special courses to teach those concerned the regulations about driving, running and maintaining fork lift trucks. These courses are more or less comprehensive according to the degree of use made of such machines.

On the other hand, on certain Railways,

professional instructional courses have been instituted for :

— loaders to deal above all with the problems due to the co-existence of palletized and non-palletized parcels;
— employees who have to make up pallet (consignments, transhipment centres), courses which deal more particularly with the way or ensuring a stable load.

These courses, which are developed to a greater or lesser extent according to the country, are of the utmost importance, as the making up of the pallets and the way they are stowed in the wagons dictates to a great extent the success of palletization.

c) Palletization has not in general resulted in the up-grading of the staff handling the pallets; the specialisation of the staff driving the fork-lift trucks has sometimes resulted in an increase in their wages, either in the form of up-grading or as an output bonus.

In general, however, the Administrations who have introduced it, consider that palletization has improved productivity and, because of this has had a favourable effect on the general wage conditions for the staff as a whole.

36. Attitude of customers. - Their reasons.

Customers are only interested in the palletization of their goods when their consignments amount to the load of at least one pallet. This excludes nearly all the traffic in multiple consignments of little weight or volume.

But when these conditions are met, the customers see in palletization either a means of reducing their packing costs by the use of box-pallets, especially closed in box-pallets (the case with the consignment of bottles of wine in France) or a reduction in handling costs, or sometimes both together.

It should also be noted that many goods have been taken away from the railway and given to competing methods of transport because the latter had less strict requirements about packing. To the extent to which pallets make possible a reduction in such packing, they are a weapon against competition.

In this connection, it is of interest to report here in extenso the reply received from the D.B. :

« Commerce and Industry are strongly interested in reducing to the greatest possible extent, the costs involved in transport. This is why they have also endeavoured to reduce the cost of *packing for transport* and to send goods without any packing or only a light packing. In this connection, they have always contended that it is up to the transport undertaking to reduce the possibility of It is for this reason that numerous goods being consigned with only a light packing. It is for this reason htat numerous goods have been taken away from the railway to other methods of transport where requirements about packing were less severe. The possibility of consigning goods on or in pallets, with which intermediate handling of goods is avoided, has therefore been favourably received by the public and has already restored to the railway certain goods. Customers also recognise that the use of pallets for the transport from the consigning station to the destination station and the suppression of handling operation thereby obtained, ensures greater security for regular reception at the destination station. »

When it is only a question of palletization for transport, there is not usually any major difficulty, and customers willingly agree to use pallets identical to those of the corresponding Railway Administrations.

It is not always so however in the case of firms which are going to effect, and more particularly those which have already effected internal palletization for handling and storing on their own behalf; such undertakings are not however very numerous on the Railways who replied to our questionnaire.

It should in fact be pointed out that

internal palletization is above all profitable and valuable in the case of large undertakings with important mass production; it can also be of benefit however for many average sized undertakings, and great interest is being taken in palletization at the present time, especially when customers see pallets and their handling gear on the station platforms.

The problems in connection with internal handling and storing are sometimes however very different from the problems raised in connection with railway transport.

The former are always of a personal character and those concerned are always tempted to choose the solution which is specially suitable for their own case, especially in so far as the measurements of the pallets are concerned; in the same way, undertakings considering stocking goods for long periods tend to favour cheap types of pallets even if these are not very strong.

On the other hand, when considering the problem of transport, it is interesting to avoid any weakness in the pallets in view of the numerous handlings they will have to stand up to, nor is it possible to consider using several types of different dimensions in view of the user of the handling gear, as well as stacking inside the vehicles.

All the Administrations concerned therefore consider that internal palletization in an undertaking should be publicized from a double point of view : on the one hand, to make those concerned understand all the advantages of this technique and on the other to persuade them to adopt the same dimensional and constructional characteristics as those adopted by the Railway System; the adoption of « Railway type » pallets is the only way of achieving « pools » which avoids the costly business of returned empties.

The D.B., C.F.F. in this connection stress the part that can be played by railway agents in advising the undertakings. Such intervention is greatly facilitated when the railway's public relations officers (Officials of the Operating and Commercial Departments, Heads of Goods Depots, etc.) have broached the subject during the course of their ordinary contacts with customers.

37. Tariffs for transport by pallets and box-pallets.

Countries where palletization has reached a certain development have published special tariffs applicable to transport carried out by means of pallets or box-pallets. These rates only apply as a rule if they comply with certain technical standards as published by the Railways.

The Tariffs usually make a distinction between two categories :

— so called « Railway pallets », because they belong to a Railway Administration, or to customers who have had them built to the technical plans and specifications of the Railway in order that they can be used in the « pool »;

— private pallets, whose principal characteristics differ from those adopted by the Railway, but which the latter has nevertheless passed for use.

It should be noted however that on the D.B., the conditions for the use of pallets by customers are not fixed by the rates but by internal regulations. The D.B. considers that this is a more flexible procedure which can be easily adapted to a position in evolution.

Transport in pallets or box-pallets is subject to the following conditions :

1) *Deduction of the tare weight of pallets.*

To establish the transport charge, scales are used corresponding to the goods to be carried based on the gross weight of the consignment less the tare weight of the pallet. However, in order to avoid having to carry too much dead weight for nothing, the Administrations have laid down.

per category of pallet, the maximum weight which can be deducted :

— in the case of simple pallets : 25 kg as a rule (30 kg in the case of the 1 000 × 1 200 pallets of the D.B.);

— for box-pallets :
in Germany, 70 kg;
in France, 100 kg;
in Belgium, 60 kg;
in Switzerland, 120 kg.

The maximum reduction is higher in France and Switzerland because of the use made by these Administrations of closed in box-pallets which are relatively heavy.

It should be pointed out that the Finnish Railways give in addition a reduction of 5 % on transport rates for palletized traffic.

2) *Minimum weight charged for.*

The Administrations have fixed a minimum weight to be paid for to avoid the pay load being too low in relation to the total weight carried. As the following table shows, this minimum varies from 5 to 200 kg, the I.R.U. (U.I.C.) having moreover fixed it at 200 kg for international traffic.

It should be noted that certain Administrations impose severer conditions in the case of private pallets in order to encourage customers to use the railway pallets.

3) *Maximum gross weight.*

This maximum, which is 1 000 kg, makes it possible to standardise the strength of the floors and the wagon floors and to use the present types of handling machines under good conditions. The admission of heavier loads would lead to much higher equipment costs and certain handling difficulties, especially in the case of the hand pallet-carriers.

4) *Allocation of so called « Railway pallets ».*

In general, the Administrations allocate free of charge to their customers, both pallets and open box-pallets, according to the kind of parcels to be transported.

Minimum weight charged for

	Railway pallet	*Private pallet*
Germany (DB)	200 kg or full capacity	fixed by agreement
Austria (ÖBB)	200 kg	200 kg
Belgium (SNCB)	50 kg	200 kg
Denmark (DSB)	100 kg	100 kg
France (SNCF)	200 kg (1)	200 kg
Switzerland (CFF)	80 kg	80 kg (reduced to 40 kg in the case of small pallets of 600 × 810)
Czechoslovakia (CSD) . . .	200 kg	200 kg

(1) It is considered to reduce this minimum weight to 100 kg for certain classes of goods.

Some of them (C.F.F., S.N.C.F.) hire out the closed box-pallets.

Such allocations are generally governed by definite time limits with penalties when it is exceeded.

5) *Rates for the return of private pallets empty.*

In order to encourage the development of palletization for railway transport, the Administrations have introduced a special rate for returned empties which were carried by rail when loaded.

In nearly all countries these rates are lower than the rates for « Returned Empties »; transport is even free in some countries where the distances are restricted (Switzerland, Austria, Denmark).

38-39. **Results obtained.**

As a general rule the Administrations are taking all possible steps to get consignors to send in palletized consignments so as to get a continuous transport from producer to utiliser by this means.

On the C.F.F., palletization by consignors is very highly developed and contracts have been made with 835 private firms. On the other hand, this question is only in its initial stages on many Administrations who, however, consider the first results obtained so far very encouraging.

The D.B. considers the pallets are only of interest to the consignor when they can be used at one and the same time for internal handling operations, storage and transport. In this case, however, to start using them means investing a considerable amount of capital, which puts a brake on their development. It should be noted in this connection that to facilitate the introduction of palletization of private undertakings, the D.B. is thinking of giving up using for its box-pallets wide mesh sides with V opening and replacing these by trellis sides one of which can be removed, as this method of manufacture is more suitable for storing them in the stores.

The S.N.C.F. points out that private firms are sometimes reluctant to introduce palletization according to the railway standard dimensions.

Finally, it should be noted that the Administrations are not considering systematic assistance to users in handling pallets or making up palletized consignments, but that some of them (D.B., S.N.C.F.) are trying to encourage the introduction of palletization amongst their customers by lending them free of charge for short periods both pallets and handling gear.

40 to 42. **Making pallets and box-pallets available to customers. - Operating a « pool ».**

In general, apart from allocations during the journey as laid down in the tariff (see question 37) governed by strict time limits, the Administrations neither lend nor hire out pallets or box-pallets to their customers.

On the other hand, they give private firms a chance of purchasing pallets and box-pallets identical to those used by the railway and of operating them as a pool with them.

Operating as a pool.

In order to imbricate « private » and « transport undertaking » palletizations and thus bind their customers more closely to them, whilst allowing them to contribute to the capital investment that such palletization involves, the Administrations all stipulate that pallets and box-pallets shall be operated in a pool with those of private firms. This common user is based on the following principles :

a) the pallets, bought by private firms, are of exactly the same type as those used by the Railway. The latter moreover controls their manufacture and only allows them to be put in circulation after it has added its own distinctive marks;

b) every time a pallet comes back to the railway, the latter replaces it with a pallet (empty or loaded) of the same type. Likewise when the client receives a loaded pallet from the Railway, he hands over another pallet (empty or loaded). There is therefore compensation number by number;

c) the client undertakes to send a tonnage by rail which is fixed when his agreement is drawn up.

These principles which were given in the questionnaire have in practice been agreed by the Administrations who have adopted the pool formula, but the methods of application vary from country to country. Such variations mainly concern the stock put in the pool and certain rebates.

a) The pool system is used :

— for simple pallets : in Germany, Belgium (proposed), Finland, France and Switzerland;

— for open box-pallets : in Germany, Finland, France and Switzerland (in the latter country open box-pallets have been replaced by simple pallets with raised removable sides);

— for closed box-pallets : in France.

b) Compensation is carried out without payment for pallets and open box-pallets. In France, the only country in which pools are used for closed box-pallets, compensation takes place on payment of a small sum similar to that charged for reserving a seat for a journey.

c) Compensation for pallets in principle takes place immediately.

On the one hand, however, immediate compensation is often difficult (unbalanced traffic or insufficient stock in view of the increasing demands of customers) or useless (multiple deliveries throughout the day, combined with collections for example), and on the other hand, such immediate conpensation means that the transport undertakings has to bear the full cost of having the stock immobilised during transport and the cost of distributing the stock. For this reason, more flexible regulations to the benefit of the Railway have been made to this rule by certain Administrations.

In addition, certain Administrations (C.F.F., D.B.) will accept with the pallet certain non-exchangeable extras which are returned free of charge when empty. The S.N.C.B. which is considering the same method thinks it would be possible to pool the most widely used extras. On the other hand, the D.B. is considering no longer returning these extras free of charge when the stock of box-pallets with trellis sides is sufficient, and the S.N.C.F. has no intention of introducing special rates for such extras.

Finally, the Administrations do not mention any difficulties in connection with the progressive introduction of such « pools ». The S.N.C.F. makes it clear that the « railway » stock will have to grow to a corresponding extent but as far as it is concerned, the demands of its customers to date have not been of sufficient size to involve any difficulty about the capital investment.

In conclusion, customers are very interested in the possibilities of pools of pallets and box-pallets, a formula which makes it possible to reduce the stock required, simplifies checking the movement of stock and does away with the cost of empty runs. The Railway sees in it a possibility of making economies in handling and above all a possibility of assuring a better quality parcels traffic, because it will be faster and more or less free from any risk of damage.

[625 .285]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

17th. SESSION (MADRID, 1958).

QUESTION 3.

Design and improvement of railcars and multiple-unit diesel trains, as regards :

— traction power equipment (location and suspension of the engine, type of transmission);

— characteristics of the construction (body and bogies);

— weight reduction;

— sound-proofing, heating, ventilation, air conditioning (supply of power required, advantages and drawbacks);

— buffer and traction gear. Intercommunication.

REPORT

(Austria, Belgium and Colony, Bulgaria, Cambodia, Czechoslovakia, Denmark, Ethiopia, Finland, France and French Union, Greece, Hungary, Indonesia, Italy, Lebanon, Luxemburg, Netherlands, Poland, Portugal and overseas territories, Rumania, Siam, Spain, Switzerland, Syria, Turkey, Viet-Nam and Yugoslavia),

by A. S. Canavezes Jr.,

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SUMMARY.

I. Introduction.

A. Analysis of the information received from the participating Administrations;

B. Numerical data of a general nature relative to the Railways and use of diesel traction;

C. Detailed information concerning railcars.

II. Ideas and opinions of the Administrations concerning the design and improvement of railcars.

A. Object of using railcars;

B. Standardisation of railcars;

C. Improvement of railcars :

1) Motor equipment (engine, transmission and drive);

2) Body, bogies and their suspension;
3) Weight reduction;
4) Sound proofing;
5) Heating, ventilation and air conditioning;
6) Buffing and traction gear. — Intercommunication.

D. Cost of operating railcars.

III. Summaries.

I. INTRODUCTION.

A. Analysis of the information received from the participating Administrations.

The questionnaire on which the present report is based was drawn up in collaboration with Dr. Eng. G. A. GAEBLER, Ministerialrat in der Hauptverwaltung der Deutschen Bundesbahn, Reporter for the English speaking countries.

As regards the French speaking countries, the questionnaire was sent by the Association to 75 Railway Administrations and organisations, covering in all about 211 000 km (130 500 miles) of lines.

The result of this enquiry was as follows :

— 18 Administrations, representing 124 750 km (77 600 miles) of lines answered the questionnaire;

— 57 did not reply or stated that as they had no railcars on their lines, or only very few, they were not able to supply any useful information.

We have shown in Table 1, the Administrations who supplied information taken into account in our report, and in Table 2, those who stated they were unable to answer the questionnaire.

It must be added that amongst the first named a relatively high number were able to supply only limited information.

We wish to express our gratitude to all those Administrations who to a greater or lesser extent but in a spirit of collaboration supplied us with information.

* * *

B. Numerical data of a general nature relative to the Railways and the use of diesel traction.

In Table 3, we have collected together for each Administration the essential characteristics of the railways and data concerning the general use of diesel locomotives and railcars.

It will be noted that certain Administrations were not able to supply all the data covered by these tables.

However, in order to give an approximate idea of the general position on the European and other Administrations as a whole who replied to the questionnaire, according to the general information received we have established the following percentages for the two groups of Administrations :

a) percentage of length :
— standard gauge main lines;
— standard gauge secondary lines, and
— narrow gauge lines,
compared with the total length of the systems;

b) percentage of the length of lines operated, exclusively or otherwise, with diesel trains and railcars, compared with the total length of the systems;

c) percentage of the number of trains-km and tons-km :
— for the passenger services;
— diesel railcars and trains, and
— railcars only,
compared, respectively, with the total number of trains-km and tons-km;

d) percentage of number of trains-km and tons-km :
— of the diesel railcars and trains and
— diesel railcars only,
compared, respectively, with the total number of trains-km and tons-km for the passenger services;

TABLE 1.

COUNTRY	*Administrations whose replies to the questionnaire have been dealt with in the report*	*Abbreviation used to denote them in the report*
Austria	Austrian Federal Railways	Ö.B.B.
Belgium and Colonies :		
a) Belgium	Belgian National Railways Co.	S.N.C.B.
b) Colony	Colonial Transport Office (OTRACO)	OTRACO
Cambodia	Royal Cambodian Railways	Cambodia
Denmark	State Railways	D.S.B.
Finland	State Railways	Finland
France :		
a) France	French National Railways Co.	S.N.C.F.
b) Other countries of the French Union :		
Africa	Algerian Railways	Algeria
	Gafsa Railways	Gafsa
	French Equatorial Africa and the Cameroons Railways	Cameroons
	French West Africa and Togoland Colonial Railways	Togo
Italy	State Railways	F.S.
Luxemburg	Luxemburg National Railways	Luxemburg
Holland	Netherlands Railways Co.	N.S.
Poland	State Railways	Poland
Portugal and overseas territories :		
a) Portugal	Portuguese Railway Company	C.F.P.
Switzerland	Federal Railways	C.F.F.
Jugoslavia	Jugoslav Railways	Jugoslavia

e) percentage of the number of trains-km and tons-km of the diesel railcars compared respectively with the number of trains-km and tons-km for the diesel services;

f) percentage of the consumption of gas-oil by the diesel railcars compared with the total consumption for railway operating.

The graph shown in figure 1, based on

TABLE 2.

COUNTRY	*Administrations which stated they were unable to reply to the questionnaire*
Belgium and Colony :	
a) Belgium	National Light Railways Company. « Electrobel » General Electric and Industrial Co. Liège-Seraing Light Railways and extensions.
b) Colony	Lower Congo to Katanga Railway. Upper Congo to the Great African Lakes Railway.
France :	
a) France	General Light Railways Company. Northern Light Railways. Parisian Transport Board.
b) Other territories of the French Union :	
Africa	Djibouti to Addis-Ababa Franco-Ethiopian Railway. Morocco Railways. Niger-Mediterranean Railways.
Italy.	North of Milan Railways. Venitian Company for the Construction and Operation of Secondary Railways in Italy.
Switzerland	Bernese Alps Railways (Berne-Loetschberg-Simplon). Rhaetian Railways. Fribourg Railways.
Syria	Damas-Hama and Extensions.
Affilated Organisations . . .	International Sleeping Car Company. International Railway Transport Central Office. International Railway Union. Union des Voies Ferrées. Union d'Entreprises Suisses de Transport.

these percentages, on which we have indicated the total number of diesel locomotives and railcars used, give us an idea of the position on the two groups of Administrations mentioned above and makes it possible to compare them (we have excluded in calculating these percentages a small number of Administrations which supplied insufficient information, as in our opinion this does not substantially alter the results).

An examination of this graph makes it immediately apparent that :

a) on the whole of the European systems considered, diesel traction is used exclusively or in conjunction with other methods of traction on 36.9 % of the total of the lines, the narrow gauge lines only representing 8.4 % of this total; on the other hand, on the whole of the non-European systems considered, diesel traction is used, under the same

EUROPEAN NON-EUROPEAN

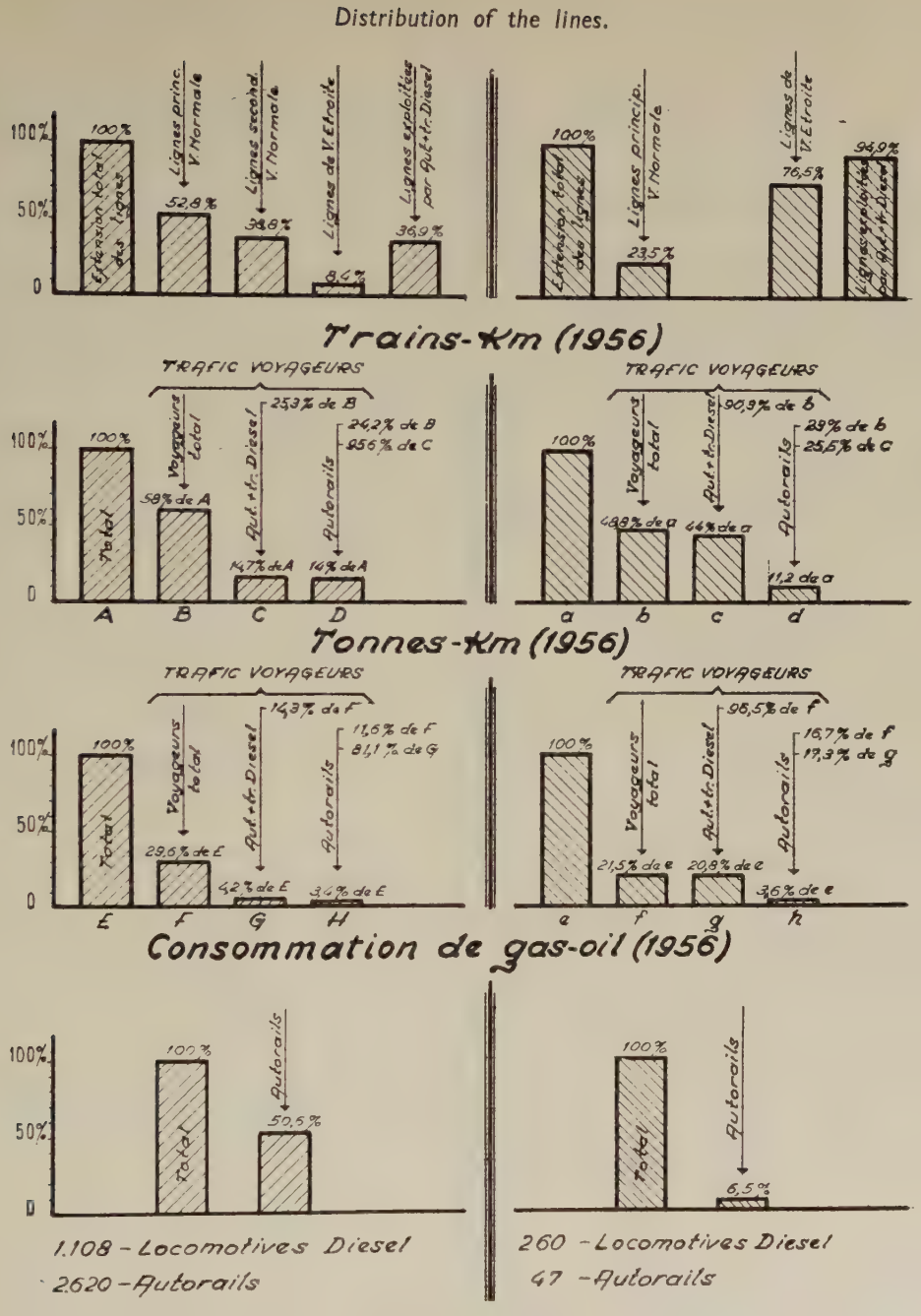


Fig. 1. — Distribution of the lines and extent to which diesel locomotives and railcars are used for the passenger traffic. (Railways as a whole.)

Explanation of the French wording (from top to bottom; left to right) :

Total mileage of lines; Main lines - standard gauge; Secondary lines - standard gauge; Narrow gauge lines; Lines operated with diesel trains and railcars. — Total mileage of lines; Main lines - standard gauge; Narrow gauge lines; Lines operated by diesel trains and railcars.

Trains-km (1956)

Total; Passenger traffic; Total passengers; Diesel trains and railcars; Railcars.

Tons-km (1956)

Same text as for trains-km.

Consumption of gas-oil (1956)

Total; Railcars; 1 108 diesel locomotives; 2 620 railcars. — 260 diesel locomotives; 47 railcars.

ADMINISTRATION	*Austrian Federal Railways*			
	Standard and wide gauge lines			Narro gaug lines
	main	secondary	total	
Length of lines in km	—	—	—	492
— single track	2 018	1 604	3 622	—
— multiple track	1 604	—	1 604	—
Total	3 622	1 604	5 226	492
Gauge in mm	—	—	1 435	760
Admissible axle load, in t	—	—	15 to 20	6 to
Length of lines worked with Diesel railcars and trains in km	V.N. 2 733 + V.E. 349 = 3 082			
Total number of trains-km in 1956	70 632 196			
— of which, total passenger service	41 829 121			
— of which, Diesel railcars and trains	8 399 959			
— of which, Diesel railcars	5 964 352			
Total number of tkm in 1956	24 131 000			
— of which, total passenger service	7 390 000			
— of which, Diesel railcars and trains	768 300			
— of which, Diesel railcars	496 900			
Total consumption of fuel oil in 1956 used for operating on railway lines in t/year	12 864			
— of which, for railcars	6 476			
Percentage of fuel oil consumption for railcars compared with total consumption on the railways	50.3			
Price of a ton of fuel oil in U.S. dollars	(national currency) 2 095 shillings			
Total number of vehicles with Diesel engines (locomotives and railcars)	—	—	156	21
— of which railcars	—	—	70	—
average number of railcars available (in service and spare), %	—	—	78.6	—
average number of railcars in service, %	—	—	76.5	—
average numb. of railc. undergoing running mainten., %	—	—	6.6	—
average number of railcars undergoing repairs (in shops), %	—	—	14.8	—
Average daily mileage of railcars, in km	—	—	233* 300**	—

* For all the railcars. ** For railcars in service.

Belgian National Railways				*Danish State Railways*			
Standard and wide gauge lines			Narrow gauge lines	Standard and wide gauge lines			Narrow gauge lines
main	secondary	total		main	secondary	total	
—	—	—	—	—	—	—	—
—	—	2 200	—	906	944	1 850	—
—	—	2 694	—	690	14	704	—
—	—	4 894	—	1 596	958	2 554	—
—	—	1 435	—	—	—	1 435	—
—	—	24	—	—	—	16 to 20	—
Diesel vehicles running nearly on the whole railway lines of the system				Diesel railcars and trains running on all the lines			
82 900 000				38 224 000			
61 000 000				29 929 000			
19 000 000				20 597 000			
15 300 000				19 428 000			
30 160 000 000				10 401 907 000			
12 785 000 000				5 914 565 000			
1 811 000 000				3 370 064 000			
823 000 000				2 770 064 000			
50 136				29 460			
9 578				26 080			
19.1				88.5			
45.61				36.90			
—	—	419	—	—	—	263	—
—	—	217	—	—	—	181	—
—	—	88	—	—	—	92	—
—	—	70	—	—	—	83	—
—	—	9	—	—	—	8	—
—	—	11	—	—	—		—
—	—	250	—	—	—	350	—

ADMINISTRATION	*Finnish State Railways*			
	Standard and wide gauge lines			Narrow gauge lines
	main	secondary	total	
Length of lines in km	—	—	—	—
— single track	4 654	2 335	6 989	—
— multiple track	548	—	548	—
Total	5 202	2 335	7 537	—
Gauge in mm	—	—	1 524	—
Admissible axle load, in t	—	—	11 to 15	—
Length of lines worked with Diesel railcars and trains in km	3 600			
Total number of trains-km in 1956	36 650 000			
— of which, total passenger service	22 940 000			
— of which, Diesel railcars and trains	6 560 000			
— of which, Diesel railcars	6 370 000			
Total number of tkm in 1956	11 995 000 000			
— of which, total passenger service	2 971 000 000			
— of which, Diesel railcars and trains	271 000 000			
— of which, Diesel railcars	248 000 000			
Total consumption of fuel oil in 1956 used for operating on railway lines in t/year	4 780			
— of which, for railcars	4 110			
Percentage of fuel oil consumption for railcars compared with total consumption on the railways	86			
Price of a ton of fuel oil in U.S. dollars	45 : 30			
Total number of vehicles with Diesel engines (locomotives and railcars)	—	—	102	—
— of which railcars	—	—	81	—
average number of railcars available (in service and spare), %	—	—	78	—
average number of railcars in service, %	—	—	76	—
average numb. of railc. undergoing running mainten., %	—	—	83***	—
average number of railcars undergoing repairs (in shops), %	—	—	17	—
Average daily mileage of railcars, in km	—	—	17 400**	—

* For R G P and T E E sets.

** For all the railcars.

French National Railways				*Italian State Railways*			
Standard and wide gauge lines			Narrow gauge lines	Standard and wide gauge lines			Narrow gauge lines
main	secondary	total		main	secondary	total	
—	—	—	720	—	—	—	400
4 820	16 050	20 870	—	2 812	6 528	9 340	—
15 530	1 350	16 880	—	2 047	—	2 047	—
20 350	17 400	37 750	720	4 859	6 528	11 387	400
—	—	1 437 - 1 465	1 000	—	—	1 435	950
—	—	17 to 18	—	—	—	15 to 18	13
V.N. 10 534				V.N. 11 387 + V.E. 400 = 11 787			
389 646 000				—			
203 071 000				—			
82 513 000				—			
82 381 000				39 245 377			
192 976 000 000				—			
53 968 000 000				—			
5 808 000 000				—			
5 788 000 000				2 940 308 400			
100 590				—			
59 910				26 740			
59.5				—			
54.86				39			
—	—	1 961	—	—	—	—	—
—	—	992	—	—	—	831	25
—	—	89.7	—	—	—	86.6	88
—	—	—	—	—	—	71.2	80
	—	6.2	—	—	—	6.7	4
—	—	3.3	—	—	—	6.7	8
—	—	275 – 365*	—	—	—	240	160

** This number seems too high (it may be due to misunderstanding of the question).

ADMINISTRATION	*Luxemburg National Railways*			
	Standard and wide gauge lines			Narro gaug lines
	main	secondary	total	
Length of lines in km	—	—	—	—
— single track	63.919	155.461	219.380	—
— multiple track	171.455	1.793	173.248	—
Total	235.374	157.254	392.628	—
Gauge in mm	—	—	1 435	—
Admissible axle load, in t	—	—	16 to 20	—
Length of lines worked with Diesel railcars and trains in km	None of the lines is exclusively operated with railca			
Total number of trains-km in 1956	4 534 114			
— of which, total passenger service	2 763 876			
— of which, Diesel railcars and trains	1 892 598			
— of which, Diesel railcars	1 713 500			
Total number of tkm in 1956	1 673 937 923			
— of which, total passenger service	290 955 252			
— of which, Diesel railcars and trains	126 809 778			
— of which, Diesel railcars	85 333 938			
Total consumption of fuel oil in 1956 used for operating on railway lines in t/year	4 140			
— of which, for railcars	1 046			
Percentage of fuel oil consumption for railcars compared with total consumption on the railways	25.2			
Price of a ton of fuel oil in U.S. dollars	48.89			
Total number of vehicles with Diesel engines (locomotives and railcars)	50	—	50	—
— of which railcars	26	—	26	—
average number of railcars available (in service and spare), %	80	—	80	—
average number of railcars in service, %	73	—	73	—
average numb. of railc. undergoing running mainten., %	10	—	10	—
average number of railcars undergoing repairs (in shops), %	10	—	10	—
Average daily mileage of railcars, in km	4 918	—	260 - 4 918*	—

* For all the railcars. ** 298 shunting locomotives included.

eneral information *(continued)*.

Netherlands Railways				*Polish State Railways*			
Standard and wide gauge lines			Narrow gauge lines	Standard and wide gauge lines			Narrow gauge lines
main	secondary	total		main	secondary	total	
—	—	—	—	—	—	—	3 804.79
667	272	939	—	—	—	12 459.2	—
1 541	—	1 541	—	—	—	6 858.6	—
2 208	272	2 480	—	—	—	19 317.8	3 804.79
—	—	1 435	—	—	—	1 435	—
—	—	16 to 20	—	—	—	—	—
908				2 460			
85 185 956				233 452 306			
55 235 590				129 722 913			
15 617 051				—			
15 001 368				4 109 960			
25 703 000 000				61 737 079 000			
14 268 000 000				3 598 198 000			
2 416 500 000				—			
2 214 200 000				29 584 000			
44 000				2 900			
19 000				2 900			
43.1				100			
43.70				(national currency) 1 290 zl			
—	—	630**	—	—	—	—	—
—	—	118	—	—	—	—	—
—	—	95.3	—	—	—	66.3	—
—	—	91.0	—	—	—	60.5	—
—	—	3	—	—	—	7	—
—	—	4.7	—	—	—	26.7	—
—	—	410	—	—	—	175	—

ADMINISTRATION	*Portuguese Railways Company*			
	Standard and wide gauge lines			Narro gaug lines
	main	secondary	total	
Length of lines in km	—	—	—	769
— single track	2 241	557	2 798	—
— multiple track	353	17	370	—
Total	2 594	574	3 168	769
Gauge in mm	—	—	1 665	1 000
Admissible axle load, in t	—	—	15 to 19	9 to
Length of lines worked with Diesel railcars and trains in km	V.N. 2 236 + V.E. 395 = 2 631			
Total number of trains-km in 1956	24 764 708			
— of which, total passenger service	15 396 352			
— of which, Diesel railcars and trains	9 732 459			
— of which, Diesel railcars	5 108 728			
Total number of tkm in 1956	4 274 514 561			
— of which, total passenger service	1 772 699 830			
— of which, Diesel railcars and trains	1 369 802 873			
— of which, Diesel railcars	347 191 242			
Total consumption of fuel oil in 1956 used for operating on railway lines in t/year	15 157			
— of which, for railcars	4 260			
Percentage of fuel oil consumption for railcars compared with total consumption on the railways	28.1			
Price of a ton of fuel oil in U.S. dollars	57.00			
Total number of vehicles with Diesel engines (locomotives and railcars)	71	46	117	13
— of which railcars	31	21	52	13
average number of railcars available (in service and spare), %	—	—	—	—
average number of railcars in service, %	—	—	—	—
average numb. of railc. undergoing running mainten., %	—	—	—	—
average number of railcars undergoing repairs (in shops), %	—	—	—	—
Average daily mileage of railcars, in km	500	300	—	200

* New rolling stock put into service in 1955.

eneral information *(continued)*.

Swiss Federal Railways				*Yugoslav Railways*			
Standard and wide gauge lines			Narrow gauge lines	Standard and wide gauge lines			Narrow gauge lines
main	secondary	total		main	secondary	total	
—	—	—	74	—	—	—	2 919
—	—	1 612	—	6 193	2 627	8 820	—
—	—	1 225	—	715	—	715	—
—	—	2 837	74	6 908	2 627	9 535	2 919
—	—	1 435	1 000	—	—	1 435	600 - 750 760 - 1 000
—	—	20 to 21	13.5	—	—	14 to 18	8 to 9
~ 10				V.N. 1 691 + V.E. 431 = 2 122			
72 944 000				79 516 000			
52 313 000				35 895 000			
~ 70 000				—			
~ 70 000				1 614 000			
20 330 000 000				32 813 048			
10 650 000 000				7 897 964			
~ 3 000 000				—			
~ 3 000 000				71 835			
~ 1 800				684			
—				684			
—				100			
~ 70.0				67.0			
—	—	8	—	15	10	25	5
—	—	2	—	15	10	25	5
—	—	—	—	80	88	—	80
—	—	—	—	70	88*	—	80
—	—	—	—	5	2	—	—
—	—	—	—	25	10	—	20
—	—	~ 200	—	345	—	345	368

ADMINISTRATION	*Colonial Transport Office (OTRACO)*			
	Standard and wide gauge lines			Narro gaug lines
	main	secondary	total	
Length of lines in km	—	—	—	36
— single track	—	—	—	—
— multiple track	—	—	—	—
Total	—	—	—	36
Gauge in mm	—	—	—	1 06
Admissible axle load, in t	—	—	—	1
Length of lines worked with Diesel railcars and trains in km	365			
Total number of trains-km in 1956	—			
— of which, total passenger service	—			
— of which, Diesel railcars and trains	—			
— of which, Diesel railcars	—			
Total number of tkm in 1956	—			
— of which, total passenger service	—			
— of which, Diesel railcars and trains	—			
— of which, Diesel railcars	—			
Total consumption of fuel oil in 1956 used for operating on railway lines in t/year	10 584			
— of which, for railcars	Nil			
Percentage of fuel oil consumption for railcars compared with total consumption on the railways	—			
Price of a ton of fuel oil in U.S. dollars	(national currency) 1 960 fr.			
Total number of vehicles with Diesel engines (locomotives and railcars)	—	—	—	46
— of which railcars	—	—	—	0
average number of railcars available (in service and spare), %	—	—	—	—
average number of railcars in service, %	—	—	—	—
average numb. of railc. undergoing running mainten., %	—	—	—	—
average number of railcars undergoing repairs (in shops), %	—	—	—	—
Average daily mileage of railcars, in km	—	—	—	0

* for the whole. ** per railcar.

eneral information *(continued)*.

Algerian Railways				*Gafsa Railways*			
Standard and wide gauge lines			Narrow gauge lines	Standard and wide gauge lines			Narrow gauge lines
main	secondary	total		main	secondary	total	
—	—	—	1 821	—	—	—	455
2 214	—	2 214	—	—	—	—	—
132	—	132	—	—	—	—	—
2 346	—	2 346	1 821	—	—	—	455
—	—	1 440	1 000 - 1 055	—	—	—	1 000
—	—	16 to 20	9 to 12	—	—	—	13
V.N. 2 040 + V.E. 1 626 = 3 666				455			
11 212 500				275 256			
5 614 300				—			
5 333 200				—			
1 302 700				—			
4 360 890 000				—			
956 603 000				—			
909 267 800				—			
107 618 500				—			
~ 35 560				191 164 litres			
~ 1 340				—			
3.7				—			
(national currency) 2 398 fr./Hl				not known			
85	—	85	26	—	—	—	4
17	—	17	—	—	—	—	4
87.8	—	87.8	—	—	—	—	85
82.9	—	82.9	—	—	—	—	75
—	—	—	—	—	—	—	15
12.2	—	12.2	—	—	—	—	15
200	—	200	—	—	—	—	870*- 255**

ADMINISTRATION	*French Equatorial Africa and Cameroons Railway*			
	Standard and wide gauge lines			Narr gau line
	main	secondary	total	
Length of lines in km	—	—	—	51
— single track	—	—	—	—
— multiple track	—	—	—	—
Total	—	—	—	51
Gauge in mm	—	—	—	1 00
Admissible axle load, in t	—	—	—	1
Length of lines worked with Diesel railcars and trains in km	517			
Total number of trains-km in 1956	2 623 279			
— of which, total passenger service	1 091 730			
— of which, Diesel railcars and trains	1 091 730			
— of which, Diesel railcars	118 164			
Total number of tkm in 1956	196 804 273			
— of which, total passenger service	59 235 725			
— of which, Diesel railcars and trains	59 235 725			
— of which, Diesel railcars	6 712 253			
Total consumption of fuel oil in 1956 used for operating on railway lines in t/year	3 400			
— of which, for railcars	130			
Percentage of fuel oil consumption for railcars compared with total consumption on the railways	3.8			
Price of a ton of fuel oil in U.S. dollars	(national currency) 13 000 fr. CFA			
Total number of vehicles with Diesel engines (locomotives and railcars)	—	—	—	31
— of which railcars	—	—	—	3
average number of railcars available (in service and spare), %	—	—	—	—
average number of railcars in service, %	—	—	—	—
average numb. of railc. undergoing running mainten., %	—	—	—	—
average number of railcars undergoing repairs (in shops), %	—	—	—	—
Average daily mileage of railcars, in km	—	—	—	400

eneral information *(continued)*.

French West Africa and Togoland Colonial Railways				*Royal Cambodian Railways*			
Standard and wide gauge lines			Narrow gauge lines	Standard and wide gauge lines			Narrow gauge lines
main	secondary	total		main	secondary	total	
—	—	—	4 093	—	—	—	385
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	4 093	—	—	—	385
—	—	—	1 000	—	—	—	1 000
—	—	—	12 to 20	—	—	—	13
4 093				385			
9 782 823				737 267			
—				406 616			
—				—			
—				217 745			
1 738 480 572				203 000 000			
(there is only Diesel stock) 342 429 891				—			
—				—			
113 173 000				13 000 000			
17 000				106			
2 100				106			
12.3				100			
66 to 80				100			
—	—	—	196	—	—	—	4
—	—	—	36	—	—	—	4
—	—	—	estimat. 80	—	—	—	75
—	—	—	» 70	—	—	—	50
—	—	—	» 10 to 15	—	—	—	25
—	—	—	» 10 to 15	—	—	—	
—	—	—	225	—	—	—	630

conditions, on about 95 % of the total of all the respective systems, which cover in this case 76.5 % of the narrow gauge lines;

b) on the European systems, the diesel traction used in connection with the passenger traffic is almost exclusively by means of railcars, but only covers a relatively small part of this traffic, whereas on the non-European systems considered, nearly all the passenger traffic is assured by diesel traction, but with a relatively small use being made of railcars; however in both cases, the use of railcars for passenger traffic corresponds to about one quarter of the total number of trains-km for this traffic;

c) the European systems use 1 108 diesel locomotives and 2 620 diesel railcars, and the non-European systems 260 diesel locomotives and 47 railcars.

This briefly is the general position on the Administrations on whose replies the present report is based.

* * *

C. Detailed information about diesel railcars built between 1st January 1946 and 1st January 1957, under construction or being designed.

The essential data supplied by the Administrations about the above railcars have been collected together in Tables 4*a*, 4*b* and 4*c*.

In cases where the vehicles are closely similar, we have only included one of them in the Tables. As far as possible the standard composition of the rakes has been indicated. However, it should be noted that very often the Administrations omitted to give the standard composition, but gave a certain number of possible compositions used according to the circumstances. In such a case, we have given the maximum composition in the Tables.

Tables 4*a*, 4*b* and 4*c* relate respectively to the following three groups into which we have divided up the railcars :

1st group :

railcars for current services (as a general rule, stopping and regional) used on main or secondary lines. We have included in this group railcars used as traction units, the case for example of the railcars of the D.S.B.

2nd group :

relatively luxurious railcars for fast services (usually long distance) used on the main lines.

3rd group :

luxury railcars for international services (« Trans-Europ-Express » rakes).

Figures 2 to 21, 22 to 27 and 28 to 36 give a certain number of photographs, diagrams and performance curves for railcars of each of these three groups.

In addition, we give below information concerning the possible compositions of certain rakes which are not expressly indicated in the Tables.

Railcars of the S.N.C.F.

1st group.

The 4 types of railcars X 5 500, X 3 800, X 2 400, X 2 800, of 150, 300, 640 and 825 HP respectively, are simple railcars with no intercommunications, which can be coupled up in pairs (or with railcars of another category).

The 150 HP railcars haul exclusively four wheeled vehicles, not more than one per railcar. The maximum composition is therefore 4 units, two of which are trailers.

The 150 HP railcar can run propelling one 4-wheeled trailer, on the driving compartment end.

A 300 HP railcar can haul a coach on lines having a gradient $\leq$ 13 $^{0}/_{00}$.

The 600 and 825 HP railcars can haul respectively 3 and 4 bogie vehicles, the maximum composition being 5 units.

Reversibility is possible when there is a railcar at each end.

2nd and 3rd groups.

Each unit of the RGP and TEE rakes is reversible (no change in composition possible during the run) and includes a railcar and a trailer.

Several units can work coupled together as multiple units, driven by one man. A bellows is provided between the railcar and trailer of each unit and at the end of the rakes, on the driving compartment end. It is also possible to make up reversible rakes consisting of two railcars (one at each end) and 1 to 4 intermediate trailers.

Coupling up or uncoupling (railcar or trailer) is carried out just as in the case of ordinary coaches.

F.S. Railcars.

1st group.

The type ALn 772 railcars can run with 1, 2 or 3 motor units and the types ALn 668, 773 and 880 with one motor unit and 1 trailer or 2 motor units and one trailer.

2nd group.

The ALn 990 railcars are used in the same way as the types 880, 773 and 668.

3rd group.

The TEE rakes consist of 2 motor coaches.

Ö.B.B. Railcars.

1st group.

The type VT 5 046 railcars can haul 1 to 3 vehicles.

S.N.C.B. Railcars.

1st group.

For the simple type 603 railcars, the possible compositions are as follows :

reversible rakes :

Motor unit or Motor unit + Motor unit;

Motor unit + Trailer + Motor unit or Motor unit + Trailer + Trailer + Motor unit;

non-reversible rakes :

Motor unit + Trailer or Motor unit + Trailer + Motor unit + Trailer.

In the same way, in the case of the simple types 604 and 605 railcars that can be coupled together :

1 or 2 Motor units + 1 or 2 trailers.

D.S.B. Railcars.

1st group.

For the Mk — Fk series railcars with electric drive (rakes of 2 coaches with 2 diesel engines on a bogie of one coach and the traction motors distributed over the three other bogies), the possible compositions are :

Mk — Fk or Mk — Fk + Mk — Fk

or, by coupling up a simple series Mo railcar which also has electric drive :

Mk — Fk + Mk — Fk + Mo.

A maximum of six ordinary coaches can be hauled.

The series Mo railcars can run with 1 or 2 motor units and also haul a maximum of six ordinary coaches.

If necessary, the ordinary coaches are equipped with remote control circuits.

* * *

Owner Administration :		*Austrian Federal Railways*
Designation of type	*Unit*	VT 5 046
Normal composition of the rake		1 motor unit + 3 trailers (max
Type of intercommunication		gangway without bellows
Maximum permissible speed	km/h	100
Installed power per railcar (each motor unit)	HP	500
Number of vehicles of this type :		
a) Motor units		17
b) Trailers		20
c) Trailers with driving compartment		—
Proposed constructional programme for this type in the future		Yes
Main use		on main lines on secondary lines in passenger traffic in current service
Number of seats 1st / 2nd class :		
a) Motor unit		2nd class : 48
b) Trailer		2nd class : 80
c) Trailer with driving compartment		—
Area of luggage compartment	m^2	11
Additional space available for special usages	m^2	—
Weight empty :		
a) of the motor unit	t	45.6
b) of the trailer	t	28
c) of the trailer with driving compartment	t	—
Radius of action of a standard unit	km	450 (in the future 1 300)
Power installed / Weight of the rake	HP/t	3.8
Residual acceleration on the level when running at the maximum speed	m/sec^2	0.03*
Maximum speed up gradients of 10 ‰	km/h	69 *
Maximum speed up gradients of 25 ‰	km/h	38 *
Average annual mileage per vehicle	km	120 000
Average mileage in service between :		
— two intermediate overhauls	km	200 000
— two general overhauls	km	600 000
Average mileage in service between two breakdowns	km	47 000 (average in 1956)
Percentage of average annual cost for maintenance and repairs in relation to purchase price :		
— for a motor unit	%	5.1
— for a trailer	%	about 3.0
— for a trailer with driving compartment	%	—

* Railcar + 1 trailer fully occupied. ** For railcars : 603, 604 and 605 types.

rrent services (1st Group).

Austrian Federal Railways	*Belgian National Railways*	*Belgian National Railways*
VT 5 080	554 (simple railcar)	603 (simple railcar)
1 motor unit + 1 trailer	1 motor unit	2 motor units + 2 trailers (max.)
without intercommunication	—	without intercommunication
90	80	90
280	166	400
2	20	36
2	—	30 : 20 4-wheeled — 10 with bogies**
—	—	—
Yes	No	No
on secondary lines in passenger traffic in regional service in stopping service	on secondary lines in passenger traffic in stopping service	on secondary lines in passenger traffic in regional service in stopping service
2nd class : 60	2nd class : 71	2nd class : 99
2nd class : 66	—	2nd class : 4-wheeled : 58 - with bog. : 76
—	—	—
—	—	5.5
—	—	—
19.2	23.5	39.3
10.5	—	4-wheeled : 13.5 — with bogies 17.4
—	—	—
about 500	550	500
9.4	7	7
0.105*	0.09	0.08 : loaded railc. — 0.04 : with bog. trailer
90*	75	81 : loaded railc. — 60 : with bog. trailer
48*	35	46 : loaded railc. — 28 : with bog. trailer
70 000 (estimated)	85 000	80 000
150 000 (estimated)	150 000	150 000
450 000 (estimated)	600 000	300 000
18 000 (first year in service)	—	
—	12	Not sufficient experience to be able to give these figures
—	—	
—	—	

Owner Administration :		*Belgian National Railways*
Designation of type	*Unit*	604 (simple railc. which can be couple
Normal composition of the rake		2 motor units + 2 trailers (max
Type of intercommunication		without intercommunication
Maximum permissible speed	km/h	80
Installed power per railcar (each motor unit)	HP	356
Number of vehicles of this type :		
a) Motor units		10
b) Trailers		30 (20 4-wheeled — 10 with bogie
c) Trailers with driving compartment		—
Proposed constructional programme for this type in the future		No
Main use		on secondary lines in passenger traffic in regional service in stopping service
Number of seats 1st / 2nd class :		
a) Motor unit		2nd class : 99
b) Trailer		2nd cl. : (4-wheeled : 58 — with bogies
c) Trailer with driving compartment		—
Area of luggage compartment	m²	5.5
Additional space available for special usages	m²	No
Weight empty :		
a) of the motor unit	t	39.6
b) of the trailer	t	4-wheeled : 13.5 — with bogies : 1
c) of the trailer with driving compartment	t	—
Radius of action of a standard unit	km	600
Power installed / Weight of the rake	HP/t	6.3
Residual acceleration on the level when running at the maximum speed	m/sec²	0.08 - with 4-wheeled trailer : (
Maximum speed up gradients of 10 ‰	km/h	75 - with 4-wheeled trailer : 6
Maximum speed up gradients of 25 ‰	km/h	42 - with 4-wheeled trailer : 3
Average annual mileage per vehicle	km	80 000
Average mileage in service between :		
— two intermediate overhauls	km	150 000
— two general overhauls	km	300 000
Average mileage in service between two breakdowns	km	
Percentage of average annual cost for maintenance and repairs in relation to purchase price :		Not sufficient experience to be able give these figures
— for a motor unit	%	
— for a trailer	%	
— for a trailer with driving compartment	%	

* For railcars : 603, 604 and 605 types.. — ** Comparatively to an isolated motor unit.

rrent services (1st Group) *(continued).*

Belgian National Railways	*Danish State Railways*	*Danish State Railways*
05 (simple that can be compled up railcar)	3 + AA (series Mo)	3 + AA + AA + AA (séries Mk-Fk)***
2 motor units + 2 trailers (max.)	2 motor units + 6 ordinary coaches (max.)	(Mk-Fk) + (Mk-Fk) + 6 ord. coaches (max.)
without intercommunication	only a gangway between motor units	interc. by means of bell. only betw. Mk & Fk
80	120	120
2 × 178	2 × 250/275	2 × 500 (whole Mk-Fk)
10	85	4
30 : 20 4-wheeled — 10 with bogies*	(ordinary coaches)	(ordinary coaches)
—	25	—
No	Yes	No
on secondary lines in passenger traffic in regional service in stopping service	on main lines and secondary lines in passenger traffic (current services) and freight. Used as a traction unit.	on main lines in passenger traffic (express services) in freight traffic used as traction unit
2nd class : 99	37	2nd class : 32 (Mk) + 78 (Fk) = 110
2nd cl. : 4-wheeled : 58 — with bogies : 76	according to type	(ordinary coaches)
—	70 - 78	—
5.5	11.8	14.5
—	—	—
41.2	65.1	71.1 (Mk) + 46.8 (Fk) = 117.9
4-wheeled : 13.5 — with bogies 17.4	according to types (ordinary coaches)	—
—	according to type : 30.1 - 33.4	—
600	about 600	600
6	8.4**	8.4****
0.08 with 4-wheeled trailer : 0.04	not known	not known
75 with 4-wheeled trailer : 62 42 with 4-wheeled trailer : 32	depends on the composition of the train	depends on the composition of the train
80 000	128 000	about : 150 000
150 000	120 000	120 000
300 000	about : 1 200 000	1 500 000
	not known	not known
Not sufficient experience to be able to give these figures	—	no special accounts are got out for each type of vehicles
	—	

** Rake with 2 units, with Diesel engine on one bogie and traction motors on 3 bogies. — **** For the whole (Mk-Fk).

Owner Administration :		*Finnish State Railways*
Designation of type	*Unit*	Dm 7 (1A) (A1)
Normal composition of the rake		1 motor unit + 1 trailer
Type of intercommunication		only a gangway for intercommunicat
Maximum permissible speed	km/h	95
Installed power per railcar (each motor unit)	HP	180
Number of vehicles of this type :		
a) Motor units		58
b) Trailers		55
c) Trailers with driving compartment		—
Proposed constructional programme for this type in the future		Yes
Main use		on main lines on secondary lines in regional services in stopping services
Number of seats 1st / 2nd class :		
a) Motor unit		2nd class : 57
b) Trailer		2nd class : 38
c) Trailer with driving compartment		—
Area of luggage compartment	m^2	(trailer) 17
Additional space available for special usages	m^2	—
Weight empty :		
a) of the motor unit	t	17.4
b) of the trailer	t	12.9
c) of the trailer with driving compartment	t	—
Radius of action of a standard unit	km	600
Power installed / Weight of the rake	HP/t	5.9
Residual acceleration on the level when running at the maximum speed	m/sec^2	0
Maximum speed up gradients of 10 ‰	km/h	—
Maximum speed up gradients of 25 ‰	km/h	—
Average annual mileage per vehicle	km	87 100 *
Average mileage in service between :		
— two intermediate overhauls	km	60 000
— two general overhauls	km	180 000
Average mileage in service between two breakdowns	km	—
Percentage of average annual cost for maintenance and repairs in relation to purchase price :		
— for a motor unit	%	—
— for a trailer	%	—
— for a trailer with driving compartment	%	—

* The 16 new motor units bought towards the end of the year 1956 have not been taken into account. *** On lines with gradients of 1

rrent services (1st Group) *(continued)*.

French National Railways	*French National Railways*	*French National Railways*
X 5 500	X 2 800	X 3 800
2 motor units + 2 trailers (max.)	1 motor unit + 4 bogie trailers (max.)	1 motor unit + 1 trailer***
gangways without bellows	gangways without bellows	gangways without bellows
120	120	120
175	825	300
32	16	130
25	229	229
—	—	—
No	Yes	but a little more powerful : 375/400
on main lines on secondary lines in passenger traffic in stopping service	on main lines on secondary lines in passenger traffic in current services	on main lines on secondary lines in passenger traffic in current services
2 × 57	74	62
2 × 31	4 × 75	75
—	—	—
motor unit : 2 × 4 — trailer : 2 × 6	5	6.3
—	—	—
16.5	47.6	30.3
6.2	17.3	17.3
—	—	—
700	1.650	600
7.7	7	6.3
—	—	—
50 with maximum composition	68.5 with maximum composition	52.5 (railcar + trailer)
30 with maximum composition	37 with maximum composition	—
—	—	—
262 000	—	312 000
483 400	—	455 700
256 400	256 400	256 400
2.68 / 10^6 **	2.05 / 10^6 **	1.61 / 10^6 **
—	—	—
—	—	—

* The S.N.C.F. prefers to give the ratio : maintenance and repair costs/km/costs price reevaluated at date in question.

Owner Administration :		*French National Railway*
Designation of type	*Unit*	X 2 400
Normal composition of the rake		1 motor unit + 4 bogie trailer (ma
Type of intercommunication		gangways without bellows
Maximum permissible speed	km/h	124
Installed power per railcar (each motor unit)	HP	2 × 375
Number of vehicles of this type : *a*) Motor units		10
b) Trailers		229
c) Trailers with driving compartment		—
Proposed constructional programme for this type in the future		No
Main use		on main lines on secondary lines in passenger traffic in current services
Number of seats 1st / 2nd class : *a*) Motor unit		68
b) Trailer		4 × 75
c) Trailer with driving compartment		—
Area of luggage compartment	m^2	4.6
Additional space available for special usages	m^2	—
Weight empty : *a*) of the motor unit	t	41.1
b) of the trailer	t	17.3
c) of the trailer with driving compartment	t	—
Radius of action of a standard unit	km	750
Power installed / Weight of the rake	HP/t	6.8
Residual acceleration on the level when running at the maximum speed	m/sec^2	—
Maximum speed up gradients of 10 ‰	km/h	—
Maximum speed up gradients of 25 ‰	km/h	—
Average annual mileage per vehicle	km	—
Average mileage in service between : — two intermediate overhauls	km	271 600
— two general overhauls	km	459 800
Average mileage in service between two breakdowns	km	256 400
Percentage of average annual cost for maintenance and repairs in relation to purchase price : — for a motor unit	%	$\frac{1.33}{10^6}$*
— for a trailer	%	—
— for a trailer with driving compartment	%	—

* The S.N.C.F. prefers to give the ratio : maintenance and repair costs/km/cost price reevaluated at date in question.

rrent services (1st Group) *(continued)*.

Algerian Railways	*Algerian Railways*	*French Equatorial Africa and the Cameroons Railways*
YZZG = type RT 6 MT J (in constr.)	ZZN	Renault AB J 6
1 motor unit + 1 trailer + 1 motor unit	2 motor units	1 motor unit + 1 trailer
gangway with bellows	gangw. w. bellows for interc. a. streamlin.	without intercommunication
85	120	60
360, limited to 300	320	300
16 : 8 rakes	—	3
8 : 8 rakes	—	3
—	—	—
—	No	No design in hand in our shops. No proposals to purchase addit. units.
on main lines on secondary lines in passenger traffic	on main lines on secondary lines in passenger traffic	on main lines in passenger traffic
2nd class : 36 3rd class : 88	2nd class : 40 3rd class : 102	51
3rd class : 44	—	76
—	—	—
13	9.40	11
cupboard : 1.30 Mail : 6.75	Mail : 4.20	Bar : 2.2
60	37	32
8	—	12
—	—	—
—	700	400
5.6	8.6	6.8
—	—	—
—	—	60
—	—	45
—	about : 95 000	45 000
—	75 000	120 000
—	600 000	240 000
—	22 000	15 000
—	—	6 M.CFA per year, i.e. 25 % about of first cost
—	—	
—	—	

Owner Administration :		*Royal Cambodian Railways*
Designation of type	*Unit*	ABH 7
Normal composition of the rake		1 motor unit + 1 trailer
Type of intercommunication		no intercommunication
Maximum permissible speed	km/h	77
Installed power per railcar (each motor unit)	HP	300
Number of vehicles of this type :		
a) Motor units		2
b) Trailers		4
c) Trailers with driving compartment		—
Proposed constructional programme for this type in the future		No
Main use		on main lines in passenger traffic express long distance services
Number of seats 1st / 2nd class :		
a) Motor unit		36
b) Trailer		56
c) Trailer with driving compartment		—
Area of luggage compartment	m^2	5.5
Additional space available for special usages	m^2	0.8 (train heating)
Weight empty :		
a) of the motor unit	t	28
b) of the trailer	t	16
c) of the trailer with driving compartment	t	—
Radius of action of a standard unit	km	700
Power installed / Weight of the rake	HP/t	6.8
Residual acceleration on the level when running at the maximum speed	m/sec^2	0.03
Maximum speed up gradients of 10 ‰	km/h	77 (with 1 trailer)
Maximum speed up gradients of 25 ‰	km/h	32 (with 1 trailer)
Average annual mileage per vehicle	km	60 000
Average mileage in service between :		
— two intermediate overhauls	km	200 000
— two general overhauls	km	400 000
Average mileage in service between two breakdowns	km	50 000
Percentage of average annual cost for maintenance and repairs in relation to purchase price :		
— for a motor unit	%	5.4
— for a trailer	%	1.05
— for a trailer with driving compartment	%	—

* Without making any distinction between different types, the total number of units is as follows : motor units : 831; trailers : 4; tr

rrent services (1st Group) *(continued)*.

Italian State Railways	*Italian State Railways*	*Italian State Railways*
ALn 772	ALn 880	ALn 668
3 motor units (max.)	1 motor unit + 1 trailer + 1 motor unit	1 motor unit + 1 trailer + 1 motor unit
gangway with bellows	gangway with bellows	gangway with bellows
130	130	110
2 × 150	450	2 × 165
not given*	not given*	not given*
Yes	Yes	Yes
on main and secondary lines in passenger traffic in regional services in stopping services	on main and secondary lines in passenger traffic in regional services	on main and secondary lines in passenger traffic in regional services in stopping services
72	80	68
—	—	68
—	80	—
—	—	4.5
train heating and mail : 0.8	train heating, mail and driv. compt. : 0.85	—
36	42	31.5
—	—	20.2
—	30	—
1 000	1 300	800
8.3	7.8	7.9
—	—	—
—	—	—
—	—	—
85 000	90 000	85 000
120 000	120 000	120 000
240 000	360 000	240 000
500 000	500 000	500 000
13	16	13
—	—	4
—	4	—

with driving compartment : 26.

Owner Administration :		*Luxemburg National Railways*
Designation of type	*Unit*	1 A
Normal composition of the rake		1 motor unit + 1 trailer
Type of intercommunication		without intercommunication
Maximum permissible speed	km/h	90
Installed power per railcar (each motor unit)	HP	110
Number of vehicles of this type :		
a) Motor units		10
b) Trailers		10
c) Trailers with driving compartment		—
Proposed constructional programme for this type in the future		No
Main use		on secondary lines in passenger traffic in current services
Number of seats 1st / 2nd class :		
a) Motor unit		2nd class : 41
b) Trailer		2nd class : 34
c) Trailer with driving compartment		—
Area of luggage compartment	m^2	trailer : 6.5
Additional space available for special usages	m^2	—
Weight empty :		
a) of the motor unit	t	10.5
b) of the trailer	t	8.3
c) of the trailer with driving compartment	t	—
Radius of action of a standard unit	km	485
Power installed / Weight of the rake	HP/t	5.8
Residual acceleration on the level when running at the maximum speed	m/sec^2	—
Maximum speed up gradients of 10 ‰	km/h	48 (railcar alone) — 40 (railcar + trail
Maximum speed up gradients of 25 ‰	km/h	22 (railcar alone) — 10 (railcar + trail
Average annual mileage per vehicle	km	63 000
Average mileage in service between :		
— two intermediate overhauls	km	300 000
— two general overhauls	km	600 000
Average mileage in service between two breakdowns	km	—
Percentage of average annual cost for maintenance and repairs in relation to purchase price :		
— for a motor unit	%	—
— for a trailer	%	—
— for a trailer with driving compartment	%	—

* Diesel, body, axles and small electrical repairs.

rrent services (1st Group) *(continued)*.

Luxemburg National Railways	*Luxemburg National Railways*	*Netherlands Railways*
B B	B-B/B-B (2 motor bogies)	DE 1
1 motor unit + 1 trailer	2 motor units	1 motor unit
without intercommunication	gangway with bellows	—
120	105	125
2 × 160	200	2 × 140
10	8	30
10	—	—
—	—	—
No	No	No
on main lines on secondary lines in passenger traffic in current services	on main lines on secondary lines in passenger traffic in current services	on secondary lines in passenger traffic in current services
2nd class : 75	2nd class : 188	73
2nd class : 81/70 (2 types)	—	—
—	—	—
motor units : 6.9 — trailer : 8.2/8.5 (2 typ.)	6.7	8
—	Mail : 6.7	—
36.5	2 × 31.6	55.8
16.1/17.5 (2 types)	—	—
—	—	—
700	900	500
5.9	6.3	5
0	0.186	0.03
78 (railcar alone) 55 (railcar + trailer)	62	65
—	39	35
90 000	—	145 000
300 000	—	100 000 (Diesel equip. only)
600 000	—	300 000* – 600 000 **
—	—	16 500
—	—	3.78 at present time — 6.65 precalculated Overhauls have not yet been completed
—	—	—
—	—	—

* 600 000 km between 2 general repairs (Diesel, body electrical equipment).

Owner Administration :		*Netherlands Railways*
Designation of type	*Unit*	DE 2
Normal composition of the rake		1 motor unit + 1 motor unit
Type of intercommunication		gangw. w. bellows for interc. a. strea
Maximum permissible speed	km/h	125
Installed power per railcar (each motor unit)	HP	2 × 180
Number of vehicles of this type : *a*) Motor units		46 (× 2)
b) Trailers		—
c) Trailers with driving compartment		—
Proposed constructional programme for this type in the future		No
Main use		on secondary lines in passenger traffic in current services
Number of seats 1st / 2nd class : *a*) Motor unit		133
b) Trailer		—
c) Trailer with driving compartment		—
Area of luggage compartment	m^2	8
Additional space available for special usages	m^2	—
Weight empty : *a*) of the motor unit	t	80.6
b) of the trailer	t	—
c) of the trailer with driving compartment	t	—
Radius of action of a standard unit	km	900
Power installed / Weight of the rake	HP/t	8.9
Residual acceleration on the level when running at the maximum speed	m/sec^2	0.03
Maximum speed up gradients of 10 ‰	km/h	65
Maximum speed up gradients of 25 ‰	km/h	35
Average annual mileage per vehicle	km	145 000
Average mileage in service between : — two intermediate overhauls	km	100 000 (equip. Diesel only)
— two general overhauls	km	300 000* – 600 000**
Average mileage in service between two breakdowns	km	16 500
Percentage of average annual cost for maintenance and repairs in relation to purchase price : — for a motor unit	%	3.78 at present 6.65 precalculated Overhauls not yet completed
— for a trailer	%	—
— for a trailer with driving compartment	%	—

* Diesel, body axles and small electrical equipment overhauls.

rent services (1st Group) *(continued)*.

Portuguese Railways Co.	*Portuguese Railways Co.*	*Jugoslavian Railways*
My 301/325 + Ry 301/312	My 101/115 + Ry 101/111	Dmot 126
1 motor unit + 1 trailer	1 motor unit + 1 trailer	1 motor unit + 1 trailer
without intercommunication	without intercommunication	without intercommunication
100	100	90
2 × 200	2 × 137	150
25	11	10
12	11	10
—	—	—
No	—	—
on main lines on secondary lines in passenger traffic in current services	on main lines on secondary lines in passenger traffic in current services	on secondary lines in passenger traffic in current services
74	72	2nd class : 60
2nd class : 106	54	2nd class : 63
—	—	—
5.25	—	—
—	—	—
51.5	27.5	13.3
31	19	9
—	—	—
600	700	500
4.8	7.5	6.7
—	—	0.08
—	—	40
—	—	20
—	—	
—	—	
—	—	
—	—	new stock, put into service in 1955
—	—	
—	—	
—	—	

600 000 km between 2 complete overhauls (Diesel, body, electrical equipment).

TABLE 4*a*. — **Railcars in current services (1st Group)** *(continued)*.

Owner Administration :		*Polish State Railways*
Designation of type	*Unit*	simple railcar
Normal composition of the rake		1 motor unit
Type of intercommunication		—
Maximum permissible speed	km/h	130
Installed power per railcar (each motor unit)	HP	2 × 150
Number of vehicles of this type : *a*) Motor units		—
b) Trailers		—
c) Trailers with driving compartment		—
Proposed constructional programme for this type in the future		—
Main use		on main lines in passenger traffic in express services
Number of seats 1st / 2nd class : *a*) Motor unit		1st class : 72
b) Trailer		—
c) Trailer with driving compartment		—
Area of luggage compartment	m^2	—
Additional space available for special usages	m^2	compartments : eng. room a. driv.: 10, service : 3.3 toilets : 1.
Weight empty : *a*) of the motor unit	t	34.2 (in running order)
b) of the trailer	t	—
c) of the trailer with driving compartment	t	—
Radius of action of a standard unit	km	900
Power installed / Weight of the rake	HP/t	—
Residual acceleration on the level when running at the maximum speed	m/sec^2	—
Maximum speed up gradients of 10 ‰	km/h	—
Maximum speed up gradients of 25 ‰	km/h	—
Average annual mileage per vehicle	km	—
Average mileage in service between : — two intermediate overhauls	km	20 000 to 30 000 (periodic overhaul) 60 000 to 75 000 (light repairs)
— two general overhauls	km	120 000 to 150 000 (general overhaul)
Average mileage in service between two breakdowns	km	—
Percentage of average annual cost for maintenance and repairs in relation to purchase price : — for a motor unit	%	—
— for a trailer	%	—
— for a trailer with driving compartment	%	—

TABLE 4*a*. — **Railcars in current services (1st Group)** *(continued)*.

Owner Administration :		*Polish State Railways*
Designation of type	*Unit*	simple railcar
Normal composition of the rake		1 motor unit + 2 trailers
Type of intercommunication		with intercommunication gangways
Maximum permissible speed	km/h	95
Installed power per railcar (each motor unit)	HP	320
Number of vehicles of this type :		
a) Motor units		—
b) Trailers		—
c) Trailers with driving compartment		—
Proposed constructional programme for this type in the future		—
Main use		on secondary lines in passenger traffic in stopping services
Number of seats 1st / 2nd class :		
a) Motor unit		2nd class : 68
b) Trailer		2nd class : 90
c) Trailer with driving compartment		—
Area of luggage compartment	m^2	4.6
Additional space available for special usages	m^2	12.6 (eng. room and driving compartment) 4.92 (2 toilets)
Weight empty :		
a) of the motor unit	t	49 (in running order)
b) of the trailer	t	33.7 (in running order)
c) of the trailer with driving compartment	t	—
Radius of action of a standard unit	km	850
Power installed / Weight of the rake	HP/t	—
Residual acceleration on the level when running at the maximum speed	m/sec^2	—
Maximum speed up gradients of 10 ‰	km/h	—
Maximum speed up gradients of 25 ‰	km/h	—
Average annual mileage per vehicle	km	—
Average mileage in service between :		
— two intermediate overhauls	km	20 000 to 30 000 (periodic overhaul) 60 000 to 75 000 (light repairs)
— two general overhauls	km	120 000 to 150 000 (general overhaul)
Average mileage in service between two breakdowns	km	—
Percentage of average annual cost for maintenance and repairs in relation to purchase price :		
— for a motor unit	%	—
— for a trailer	%	—
— for a trailer with driving compartment	%	—

Fig. 2. — *S.N.C.B.* : 554 Railcar with mechanical drive - 166 HP - 80 km/h.
(See Table 4 *a*.)

Fig. 3. — *S.N.C.B.* : 603 Railcar with hydraulic drive - 400 HP - 90 km/h.
(See Table 4 *a*.)

Fig. 4. — *D.S.B. :* Mo railcar with electric drive - 2 × 250/275 HP - 120 km/h.
(See Table 4 *a.*)

Fig. 5. — *Finnish State Railways :* Dm 7 railcar with mechanical drive - 180 HP - 95 km/h.
(See Table 4 *a.*)

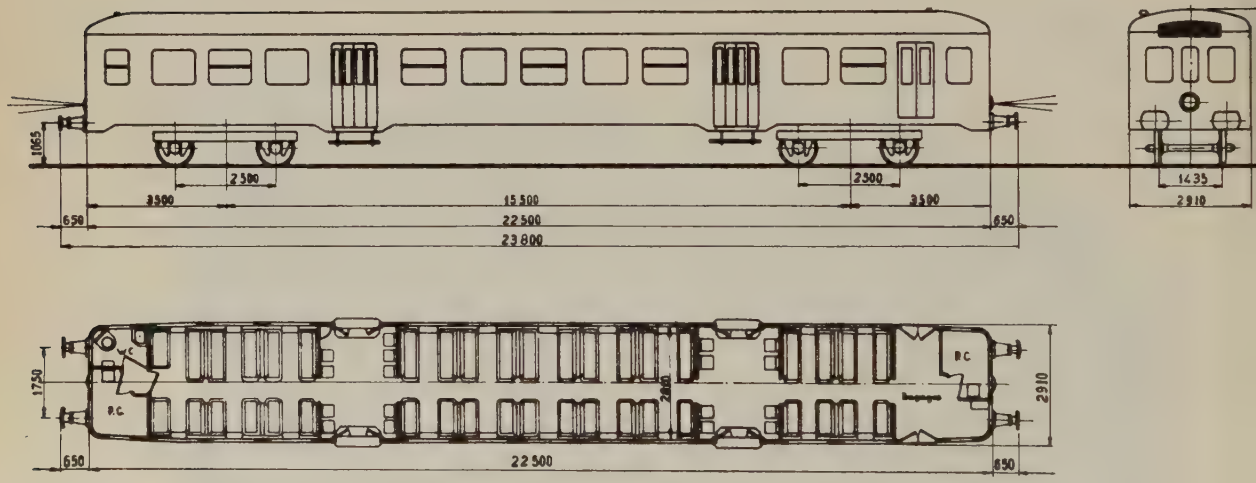
Fig. 6. — *F.S.* : ALn 880 railcar with hydraulic drive - 450 HP - 130 km/h.
(See Table 4 *a*.)

Fig. 7. — *F.S.* : ALn 668 railcar with hydraulic drive - 2 × 165 HP - 110 km/h.
(See Table 4 *a*.)

Fig. 8. — *N.S.* : DE 1 railcar with electric drive - 2 × 140 HP - 125 km/h.
(See Table 4 *a*.)

Fig. 9. — *C.F.P.* : My 301/325 railcar with electric drive - 2 × 200 HP - 100 km/h.
(See Table 4 *a* and diagram fig. 19.)

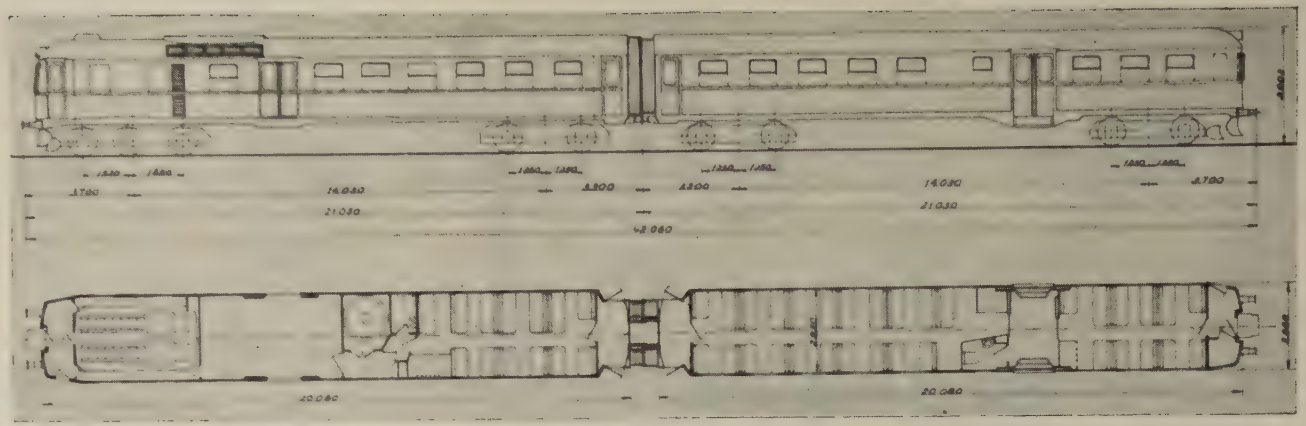
Fig. 10. — *C.F.P.* : My 301/325 railcar trailer - interior view.



GENERAL CHARACTERISTICS :

Main use	Current services.	Radius of action	600 km.
Number and power of engines	1 × 356 HP.	Total weight (tare)	39.5 t } Weight per
Drive	hydromechanical.	Total number of seats	99 } seat 400 kg.
Maximum speed	80 km/h.	Diesel engine on false frame suspended under the body to t	
		main frame by suspension rods.	

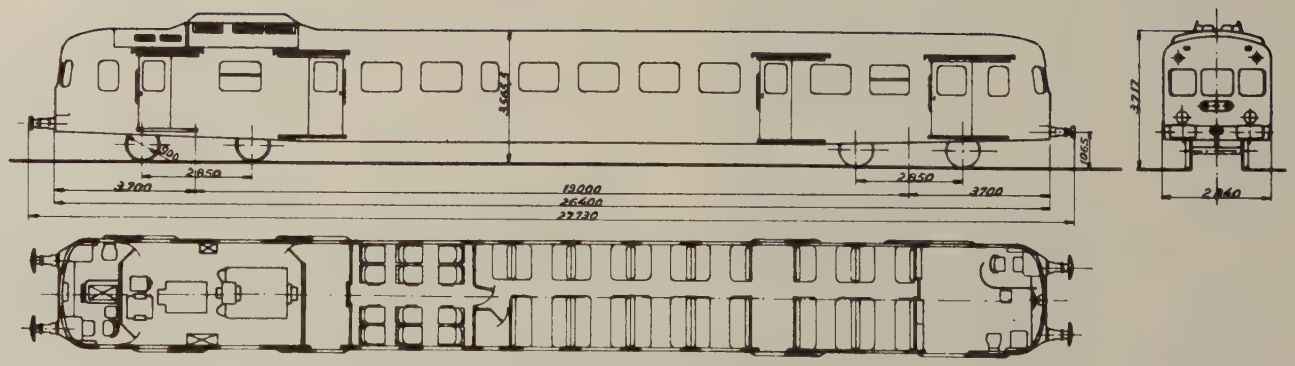
Fig. 11. — *S.N.C.B.* : 604 simple standard gauge railcar which can be coupled up.
Year of construction : 1954.



GENERAL CHARACTERISTICS :

Main use	Local services.	Radius of action	600 km.
Number and power of engines	2 × 500 HP.	Total weight (tare)	117,9 t { Weight per
Drive	Electric.	Total number of seats	110 { seat 1 071.8 kg.
Maximum speed	120 km/h.	Diesel engines on one bogie and traction motors on three bogies.	

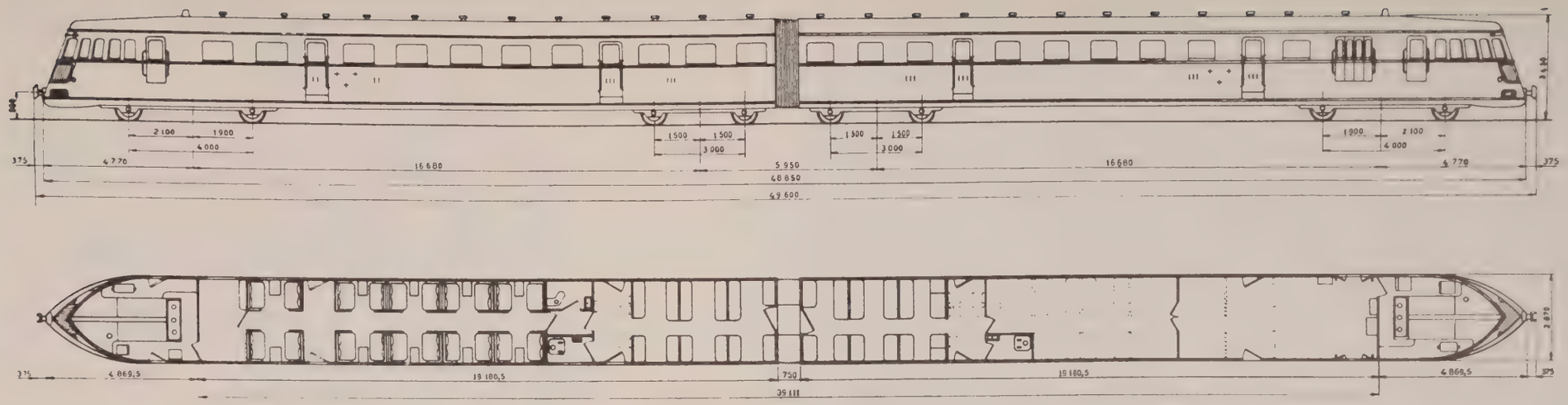
Fig. 12. — *Danish State Railways :* Double Mk-Fk standard gauge railcar. Year of construction : 1951.



GENERAL CHARACTERISTICS :

Main use	Current services.	Radius of action	1 650 km.
Number and power of engines	1 × 825 HP.	Total weight (tare)	47.6 t { Weight per
Drive	Hydromechanical.	Total number of seats	74 { seat 643.2 kg.
Maximum speed	120 km/h.	Diesel engine in the body.	

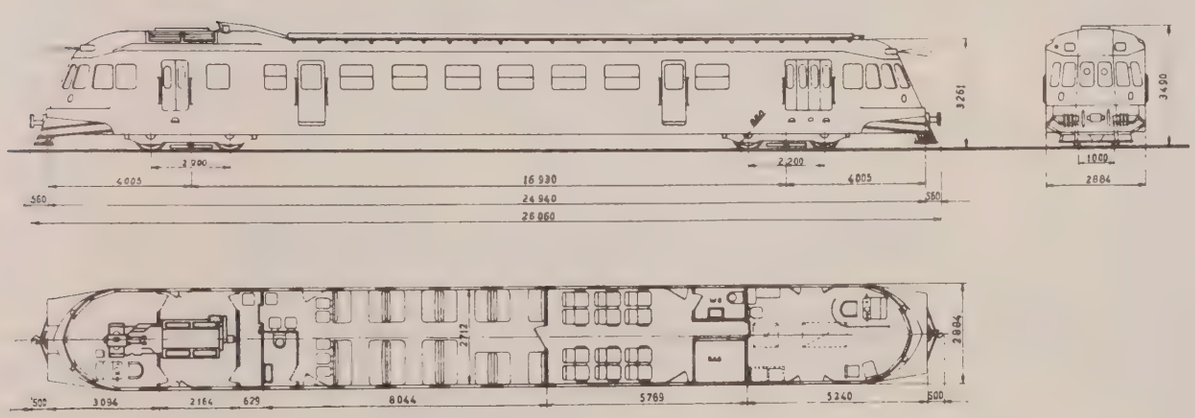
Fig. 13. — *French National Railways* : Simple X 2 800 standard gauge railcar. Year of construction : 1957.



GENERAL CHARACTERISTICS :

Main use	Current services.	Radius of action	700 km.
Number and power of engines	2 × 320 HP.	Total weight (tare)	74 t (Weight per seat 521.1 kg.
Drive	Mechanical.	Total number of seats	142 (Weight per seat 521.1 kg.
Maximum speed	120 km/h.	Diesel engines in the body.	

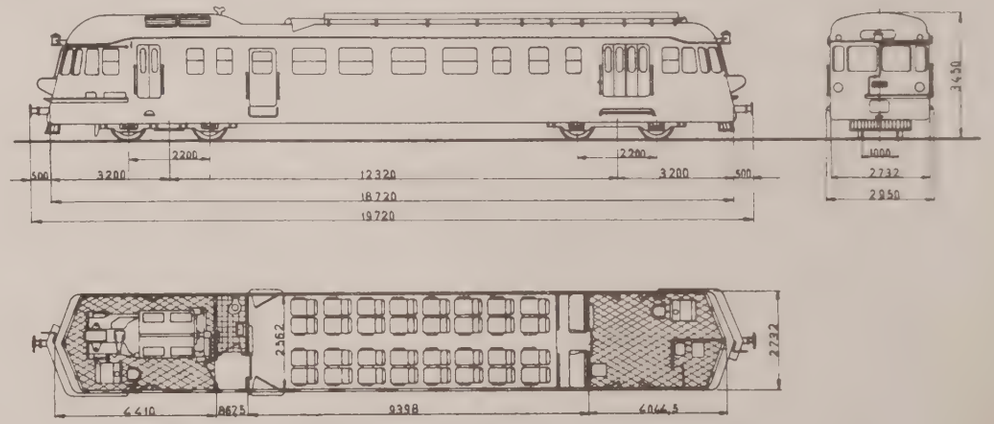
Fig. 14. — *Algerian Railways* : Double ZZN standard gauge railcar (2 motor units). Year of construction : 1951.



GENERAL CHARACTERISTICS :

Main use	Current services.	Radius of action	400 km.
Number and power of engines	1 × 300 HP.	Total weight (tare)	32 t (Weight per seat 627.4 kg.
Drive	Mechanical.	Total number of seats	51 (Weight per seat 627.4 kg.
Maximum speed	60 km/h.	Diesel engine in the body on false frame with intermediate elastic blocks.	

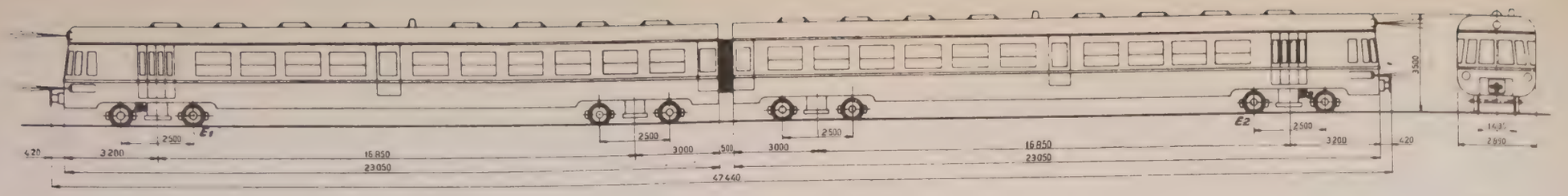
Fig. 15. — *French Equatorial Africa and the Cameroons Railways* : ABJ6 simple railcar for narrow gauge lines. Year of construction : 1949.



GENERAL CHARACTERISTICS :

Main use	Current services.	Radius of action	.700 km.
Number and power of engines	1 × 300 HP.	Total weight (tare)	.28 t (Weight per seat 777.7 kg.
Drive	Mechanical.	Total number of seats	.36 (Weight per seat 777.7 kg.
Maximum speed	77 km/h.	Diesel engine in the body.	

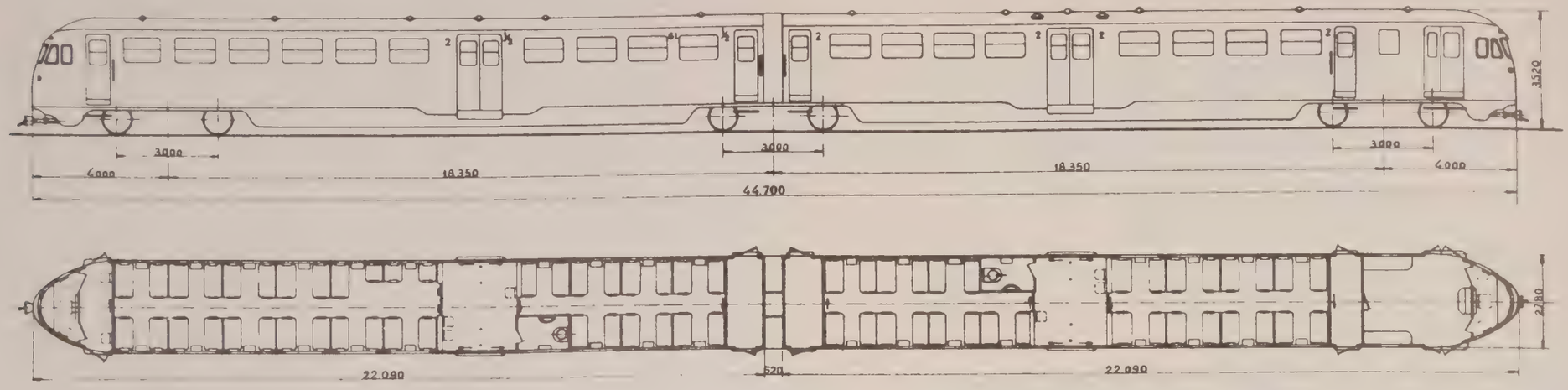
Fig. 16. — *Royal Cambodian Railways* : Simple ABH7 railcar for narrow gauge lines. Year of construction : 1947.



GENERAL CHARACTERISTICS :

Main use . . . . . Local services.
Number and power of engines . . 2 × 200 HP.
Drive . . . . . Hydraulic.
Maximum speed . . . . . 105 km/h.
Radius of action . . . . . 900 km.
Total weight (tare) . . . . . 63.2 t
Total number of seats 188
Weight per seat 336.1 kg.
Motor bogies : B 1 and B a; driving axles : E 1 and E 2.

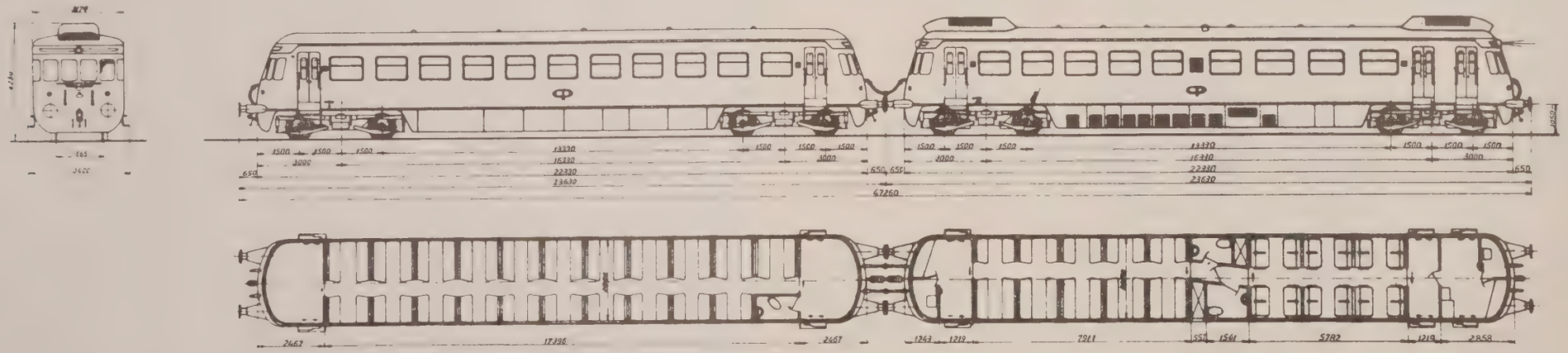
Fig. 17. — *Luxemburg Railways* : Double B-B/B-B standard gauge railcar (Two motor units). Year of construction : 1956.



GENERAL CHARACTERISTICS :

Main use . . . . . Local services.
Number and power of engines . . 4 × 180 HP.
Drive . . . . . Electric.
Maximum speed . . . . . 125 km/h.
Radius of action . . . . . 900 km.
Total weight (tare) . . . . . 80.6 t
Total number of seats 133
Weight per seat 606 kg.
Diesel engines under the body. Traction motors mounted on the outer bogies of the rake.

Fig. 18. — *Netherlands Railways* : Double « DE 2 » standard gauge railcar two motor units). Year of construction : 1953-55.

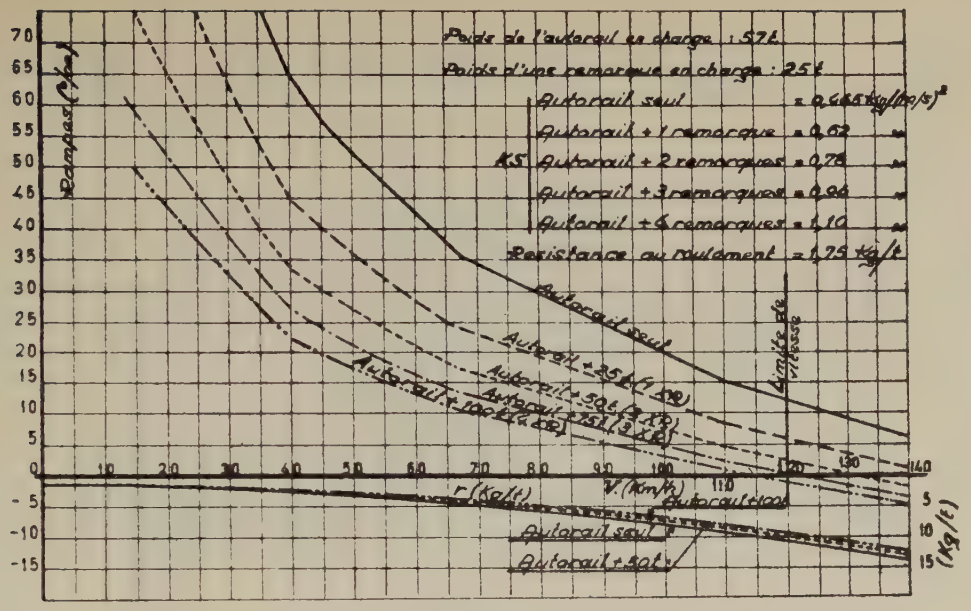


GENERAL CHARACTERISTICS :

Main use . . . . . Local services.
Number and power of engines . . 2 × 200 HP.
Drive . . . . . Electric.
Maximum speed . . . . . 100 km/h.
Radius of action . . . . . 600 km.
Total weight (tare) . . . . . 82.5 t
Total number of seats 180
Weight per seat 458.3 kg.
Diesel engines under the body (horizontal).

Fig. 19. — *Portuguese Railways* : Simple My 301/325 railcar for 1665 mm gauge lines (with one trailer). Year of construction : 1954.

Performances on up gradients.


Poids de l'autorail en charge : 57t
Poids d'une remorque en charge : 25t
Autorail seul = 0,065 kg/(km/h)²
Autorail + 1 remorque = 0,02
KS Autorail + 2 remorques = 0,78
Autorail + 3 remorques = 0,96
Autorail + 4 remorques = 1,10
Résistance au roulement = 1,75 kg/t
Rampes (kg/t)
V (km/h)
r (kg/t)
Autorail seul
Autorail + 25t (1 XR)
Autorail + 50t (2 XR)
Autorail + 75t (3 XR)
Autorail + 100t (4 XR)
Limite de vitesse

Utilisation curves.

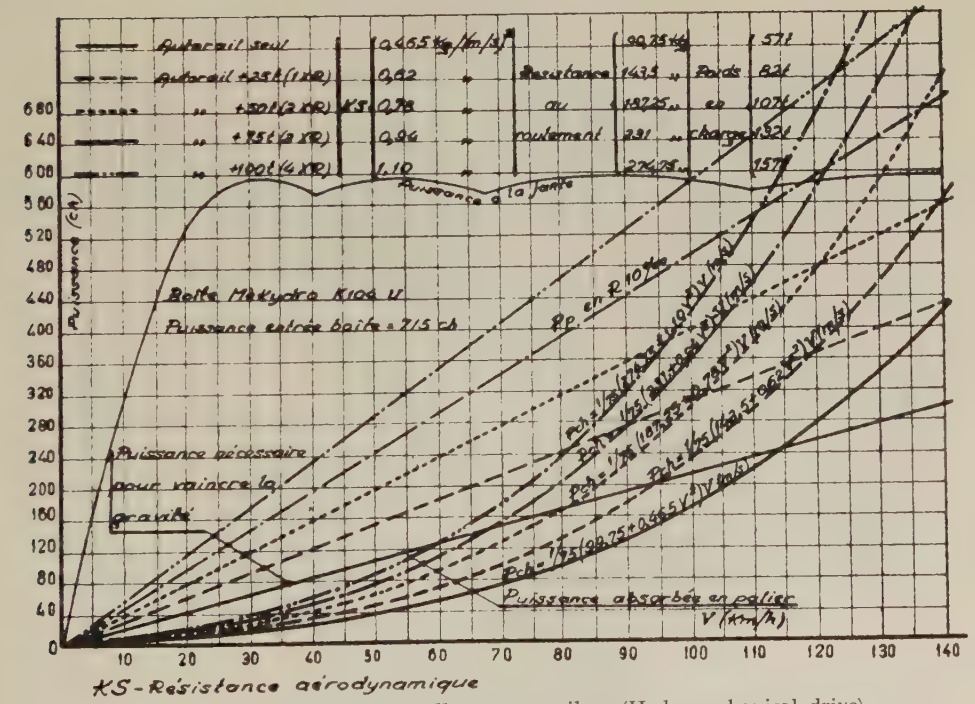
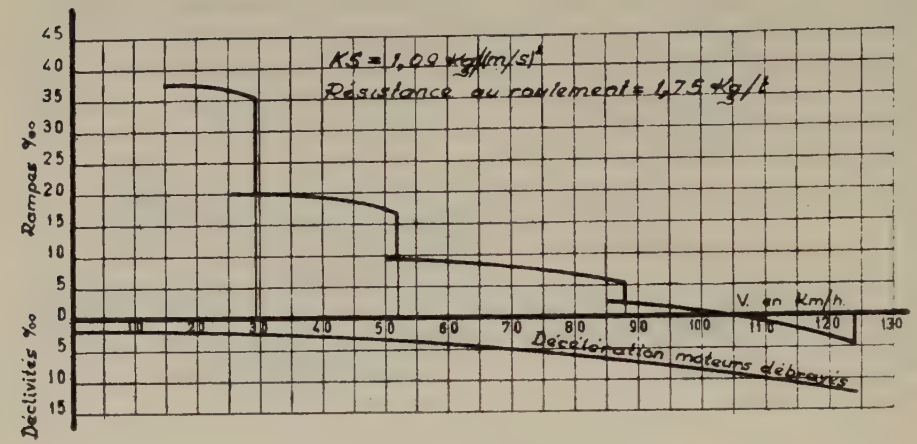


Fig. 20. — *S.N.C.F.* : X 2 800 all purpose railcar (Hydromechanical drive).

Explanation of French terms :

Rampes = gradients. — Poids de l'autorail en charge = weight of railcar loaded. — Poids d'une remorque en charge = weight of a trailer loaded. — Autorail seul = railcar alone. — Autorail + remorque = railcar + trailer. — Résistance au roulement = running resistance. — Poids en charge = weight loaded. — Puissance = power. — Boîte Mekydra = Mekydra box. — Puissance entrée boîte = power at entry to box. — Puissance nécessaire pour vaincre la gravité = power required to overcome gravity. — Puissance absorbée en palier = power absorbed on the level. — KS - résistance aérodynamique = KS - aerodynamic resistance.

Performances on up gradients.



Explanation of French wording :

Rampes = up gradients. — Déclivités = down gradients. — Résistance au roulement = running resistance. — Décélération moteurs débrayés = deceleration with motors out of gear.

Utilisation curve.

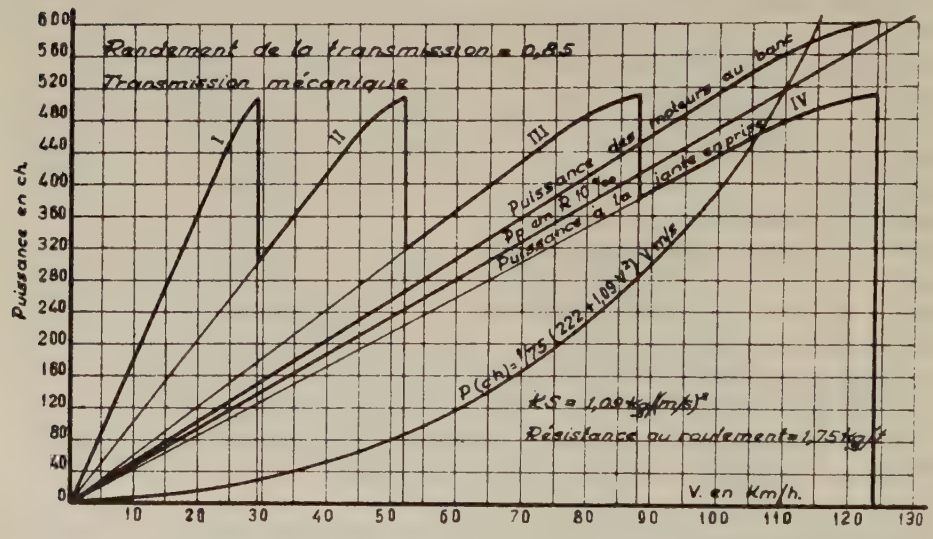


Fig. 21. — *S.N.C.F.* : Standard X 2 401 to 2 449 railcars with two Renault 300 HP engines. Railcar + three trailers.

Explanation of French wording :

Rendement de la transmission = efficiency of the drive. — Transmission mécanique = mechanical drive. — Puissance des moteurs au banc = power of the motors on the bench. — Puissance à la jante en prise = power at the tread.

Starting up under full power.

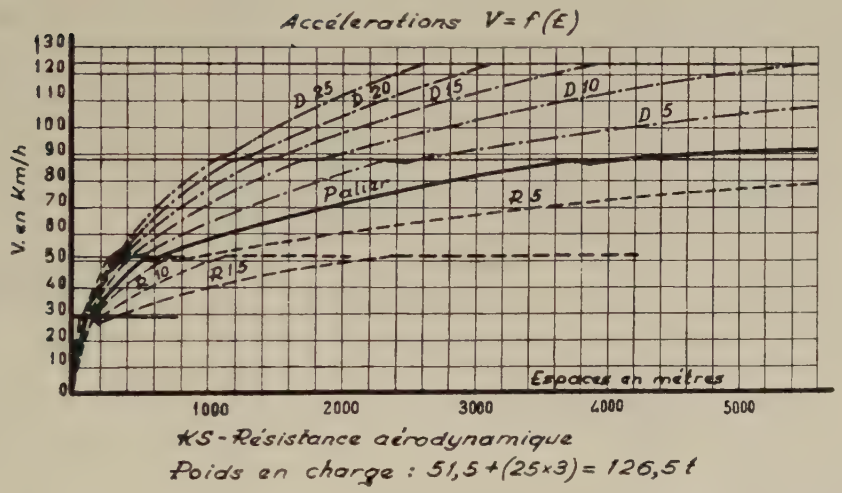


Fig. 21 *bis.* — *S.N.C.F.* : Standard X 2 401 to 2 449 railcars with two Renault 300 HP engines. Railcar + three trailers.

Explanation of French wording :

Accélérations = accelerations. — Palier = level. — KS - résistance aérodynamique = KS - aerodynamic resistance. — Poids en charge = weight loaded. — Espaces en mètres = distances in metres. — V. en Km/h = Speed in km/h.

TABLE 4b.

Railcars for fast services.

(2nd. Group.)

Owner Administration :		*Austrian Federal Railways.*
Designation of type	*Unit*	VT 5 145 + VS 6 645
Normal composition of the rake		1 motor unit + 1 trailer with driving c
Type of intercommunication		gangway with bellows
Maximum permissible speed	km/h	100
Installed power per railcar (each motor unit)	HP	550
Number of vehicles of this type : *a*) Motor units		4
b) Trailers		—
c) Trailers with driving compartment		4
Proposed constructional programme for this type in the future		No
Main use		on main lines in passenger traffic express long distance services
Number of seats 1st / 2nd class : *a*) Motor unit		2nd class : 56
b) Trailer		—
c) Trailer with driving compartment		2nd class : 80
Area of luggage compartment	m^2	—
Additional space available for special usages	m^2	restaurant and bar : 5
Weight empty : *a*) of the motor unit	t	42.4
b) of the trailer	t	—
c) of the trailer with driving compartment	t	25.3
Radius of action of a standard unit	km	600
Power installed / Weight of the rake	HP/t	8.1
Residual acceleration on the level when running at the maximum speed	m/sec^2	—
Maximum speed up gradients of 10 ‰	km/h	75
Maximum speed up gradients of 25 ‰	km/h	42
Average annual mileage per vehicle	km	13 000
Average mileage in service between : — two intermediate overhauls	km	200 000
— two general overhauls	km	600 000
Average mileage in service between two breakdowns	km	(average 1956) : 71 000
Percentage of average annual cost for maintenance and repairs in relation to purchase price : — for a motor unit	%	
— for a trailer	%	5.5
— for a trailer with driving compartment	%	

* Without making a distinction between the different types, the total number of vehicles is as follows : motor units, 831; trail

t services (2nd Group).

Colonial Transport Office (OTRACO)	French National Railways	Italian State Railways
railcar under construction	RGP X 2 721 XR 7 700	ALn 990
1 motor unit	1 motor unit + 1 trailer	1 motor unit + 1 trailer + 1 motor unit
—	gangway with bellows	gangway with bellows
80	140	130
410	825	480
railcar under construction : 3	18	not indicated*
—	—	
—	38	
Yes	No	Yes
on main lines in passenger traffic on luxury train	on long distance express services on main lines in passenger traffic	on main lines on secondary lines in passenger traffic express services
34	56	90
—	—	—
—	56	90
3.6	3.5	—
compartments : 7.1 restaur. and bar: 2.9	kitchen : 10.3	train heating, mail and driving compartment: 0.9
about : 45	46.3	46
—	—	—
—	29.55	36
—	1 650	1 100
9.1	10.8	7.5
—	—	—
—	104.5	—
—	64	—
—	—	95 000
—	283 900	150 000
—	—	450 000
—	—	500 000
—	—	15
—	—	—
—	—	4

lers with driving compartment, 26.

TABLE 4*b*. — **Railcars for fast services (2nd Group)** *(continued)*.

Owner Administration :		*Italian State Railways*
Designation of type	*Unit*	ALn 773
Normal composition of the rake		1 motor unit + 1 trailer + 1 motor unit
Type of intercommunication		gangways with bellows
Maximum permissible speed	km/h	110
Installed power per railcar (each motor unit)	HP	2 × 200
Number of vehicles of this type :		
a) Motor units		not indicated*
b) Trailers		
c) Trailers with driving compartment		
Proposed constructional programme for this type in the future		Yes
Main use		on main and secondary lines in passenger traffic in express services in regional service
Number of seats 1st / 2nd class :		
a) Motor unit		73
b) Trailer		—
c) Trailer with driving compartment		64
Area of luggage compartment	m^2	4.5
Additional space available for special usages	m^2	—
Weight empty :		
a) of the motor unit	t	41
b) of the trailer	t	—
c) of the trailer with driving compartment	t	—
Radius of action of a standard unit	km	750
Power installed / Weight of the rake	HP/t	—
Residual acceleration on the level when running at the maximum speed	m/sec^2	—
Maximum speed up gradients of 10 ‰	km/h	—
Maximum speed up gradients of 25 ‰	km/h	—
Average annual mileage per vehicle	km	85 000
Average mileage in service between :		
— two intermediate overhauls	km	120 000
— two general overhauls	km	240 000
Average mileage in service between two breakdowns	km	500 000
Percentage of average annual cost for maintenance and repairs in relation to purchase price :		
— for a motor unit	%	11
— for a trailer	%	—
— for a trailer with driving compartment	%	3

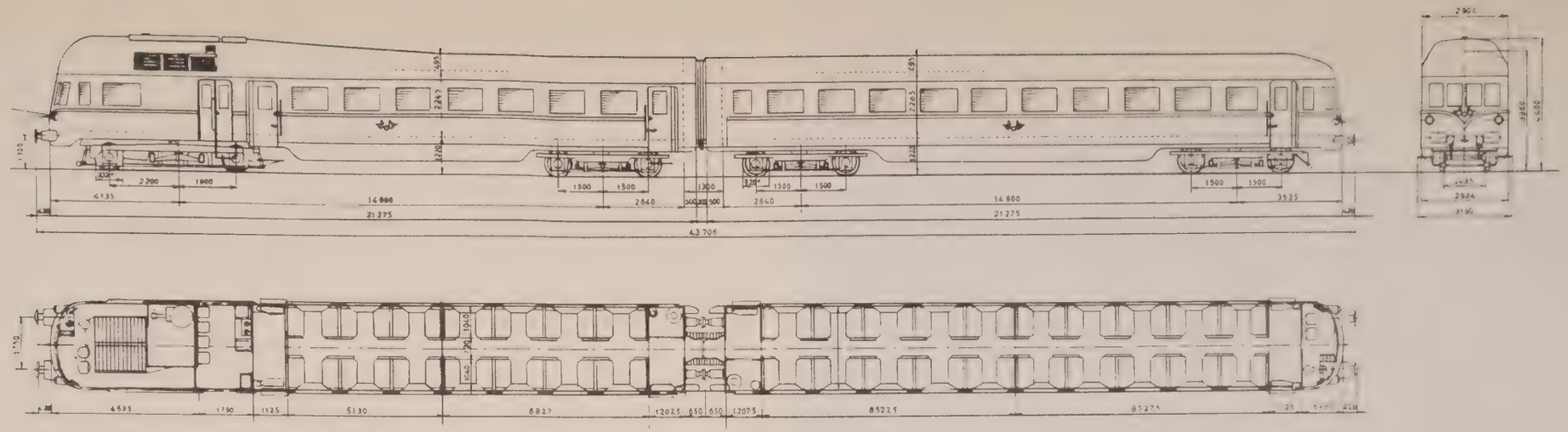
* Without making a distinction between the different types, the total number of vehicles is as follows : motor units, 831; trailers, 4
trailers with driving compartment, 26.

TABLE 4*b*. — **Railcars for fast services (2nd Group)** *(continued)*.

Owner Administration :		*Portuguese Railways*
Designation of type	*Unit*	My 501/506 + Ry 501/503
Normal composition of the rake		1 m. un. + 1 trail. w. driv. comp. + 1 m. un.
Type of intercommunication		gangway with bellows
Maximum permissible speed	km/h	120
Installed power per railcar (each motor unit)	HP	505
Number of vehicles of this type :		
a) Motor units		6
b) Trailers		—
c) Trailers with driving compartment		3
Proposed constructional programme for this type in the future		—
Main use		on main lines in passenger traffic in luxury train in express service
Number of seats 1st / 2nd class :		
a) Motor unit		1st class : 64
b) Trailer		—
c) Trailer with driving compartment		1st class : 46
Area of luggage compartment	m^2	6.758
Additional space available for special usages	m^2	Rest. and bar : 17.082
Weight empty :		
a) of the motor unit	t	56.5
b) of the trailer	t	—
c) of the trailer with driving compartment	t	45.5
Radius of action of a standard unit	km	750
Power installed / Weight of the rake	HP/t	6.3
Residual acceleration on the level when running at the maximum speed	m/sec^2	—
Maximum speed up gradients of 10 ‰	km/h	—
Maximum speed up gradients of 25 ‰	km/h	—
Average annual mileage per vehicle	km	—
Average mileage in service between :		
— two intermediate overhauls	km	—
— two general overhauls	km	—
Average mileage in service between two breakdowns	km	—
Percentage of average annual cost for maintenance and repairs in relation to purchase price :		
— for a motor unit	%	—
— for a trailer	%	—
— for a trailer with driving compartment	%	—

Fig. 22. — *F.S.* : ALn 990 railcar with hydromechanical drive - 480 HP - 130 km/h. (See Table 4 *b*.)

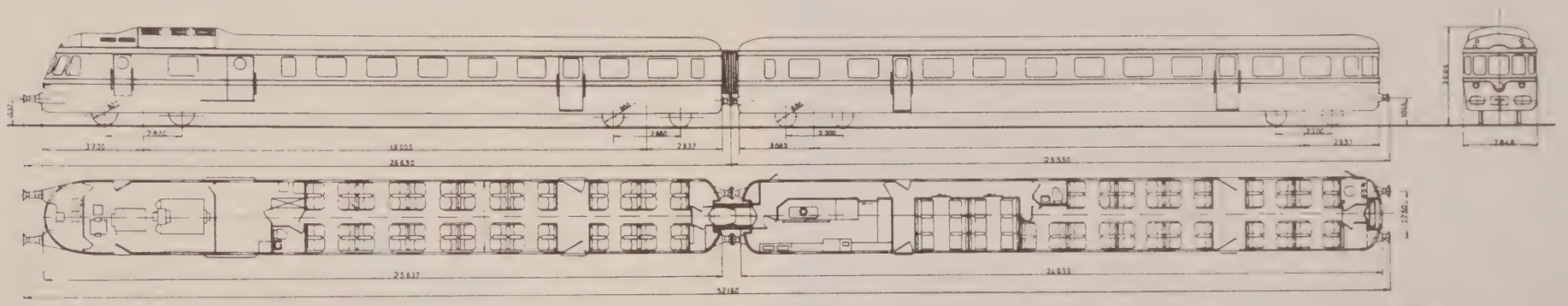
Fig. 23. — *C.F.P.* : Triple My 501/506 railcar with mechanical drive
2 × 505 HP - 120 km/h. (See table 4 *b* and diagram fig. 26.)



GENERAL CHARACTERISTICS :

Main use . . . . . Current services.
Number and power of engines . . 1 × 550 HP.
Drive . . . . . Hydraulic.
Maximum speed . . . . . 100 km/h.
Radius of action . . . . . 600 km.
Total weight (tare) . . . . . 67.7 t
Total number of seats 136
Weight per seat 497.7 kg.
Diesel engine on bogie.

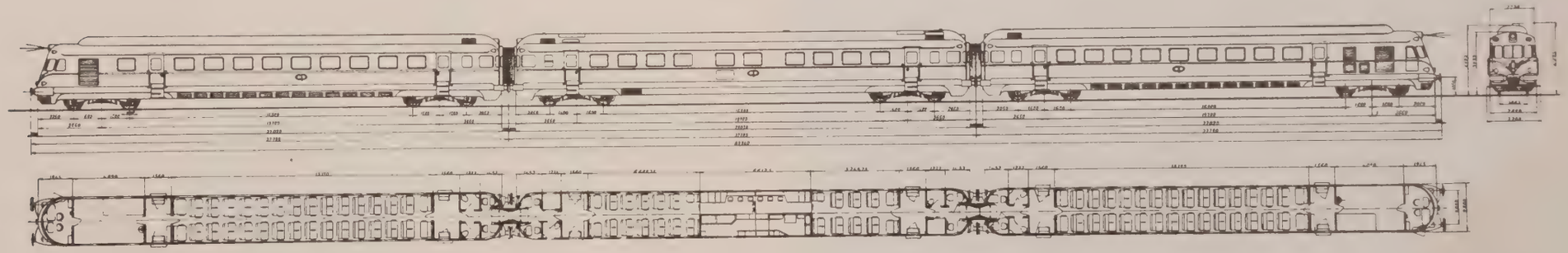
Fig. 24. — *Austrian Federal Railways :* VT 5 145 - VS 6 645 double railcar for standard gauge (1 motor unit + 1 trailer with driving compartment). Year of construction : 1956.



GENERAL CHARACTERISTICS :

Main use . . . . . Long distance express services.
Number and power of engines . . 1 × 825 HP.
Drive . . . . . Hydromechanical.
Maximum speed . . . . . 140 km/h.
Radius of action . . . . . 1650 km.
Total weight (tare) . . . . . 75.85 t
Total number of seats 112
Weight per seat 677.2 kg.
Diesel engine in the body.

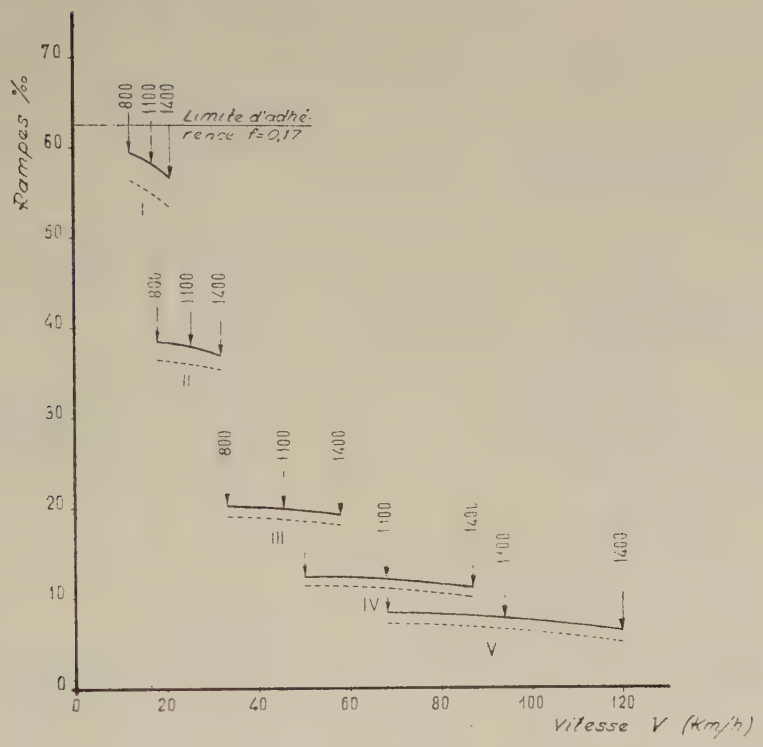
Fig. 25. — *French National Railways :* RGP double rake for standard gauge (1 motor unit +1 trailer with driv. cpt.). Year of construction : 1954-55.



GENERAL CHARACTERISTICS :

Main use . . . . . Current services.
Number and power of engines . . 2 × 505 HP.
Drive . . . . . Mechanical.
Maximum speed . . . . . 120 km/h.
Radius of action . . . . . 750 km.
Total weight (tare) . . . . . 158.5 t
Total number of seats 174
Weight per seat 909.7 kg.
Diesel engines under the body. Stone/Carrier air conditioning system.

Fig. 26. — *Portuguese Railways :* Triple My 501/506 railcar for 1 665 mm gauge lines (2 motor units + 1 trailer with driv. cpt.). Year of construction : 1953.



Weight in running order	160.794 t
Normal load	16.290 t
Weight under normal load (Q)	177.084 t
Aerodynamic resistance	$1\,348\text{-}10^{6}AV^{3}$ HP
Running resistance	0.00744 . QV HP
Frontal area	9.5 m²
Drive	Mechanical

Gear ratios

Speeds	Bridges	Gear box	Total
I	2	5.55	11.10
II	»	3.70	7.40
III	»	2.07	4.14
IV	»	1.38	2.76
V	»	1	2

The limits of the curves correspond to 800 and 1 400 r.p.m. of the engines.

— — — — — — Running with overload (50 % of normal load).

Weight of the train under overload = 185 t.

Fig. 27. — *C.F.P.* : Triple railcar My 501/506. Performance on gradients.

TABLE 4*c*. — **Rakes**

Owner Administration :		*French National Railways*
Designation of type	*Unit*	TEE X 2770 XR 7771
Normal composition of the rake		1 motor unit + 1 trailer
Type of intercommunication		gangway with bellows
Maximum permissible speed	km/h	140
Installed power per railcar (each motor unit)	HP	825
Number of vehicles of this type : *a*) Motor units		11
b) Trailers		—
c) Trailers with driving compartment		9
Proposed constructional programme for this type in the future		No
Main use		on main lines in passenger traffic in luxury train in long distance express serv
Number of seats 1st / 2nd class : *a*) Motor unit		39
b) Trailer		—
c) Trailer with driving compartment		42
Area of luggage compartment	m^2	6.35
Additional space available for special usages	m^2	kitchen : 10 customs : 1.75
Weight empty : *a*) of the motor unit	t	46.5
b) of the trailer	t	—
c) of the trailer with driving compartment	t	32
Radius of action of a standard unit	km	1 750
Power installed / Weight of the rake	HP/t	10.5
Residual acceleration on the level when running at the maximum speed	m/sec^2	—
Maximum speed up gradients of 10 ‰	km/h	104
Maximum speed up gradients of 25 ‰	km/h	62.5
Average annual mileage per vehicle	km	—
Average mileage in service between : — two intermediate overhauls	km	—
— two general overhauls	km	—
Average mileage in service between two breakdowns	km	—
Percentage of average annual cost for maintenance and repairs in relation to purchase price : — for a motor unit	%	—
— for a trailer	%	—
— for a trailer with driving compartment	%	—

* Making no distinction between different types, the total number of vehicles is as follows : motor units, 831; trailers, 4; trailer

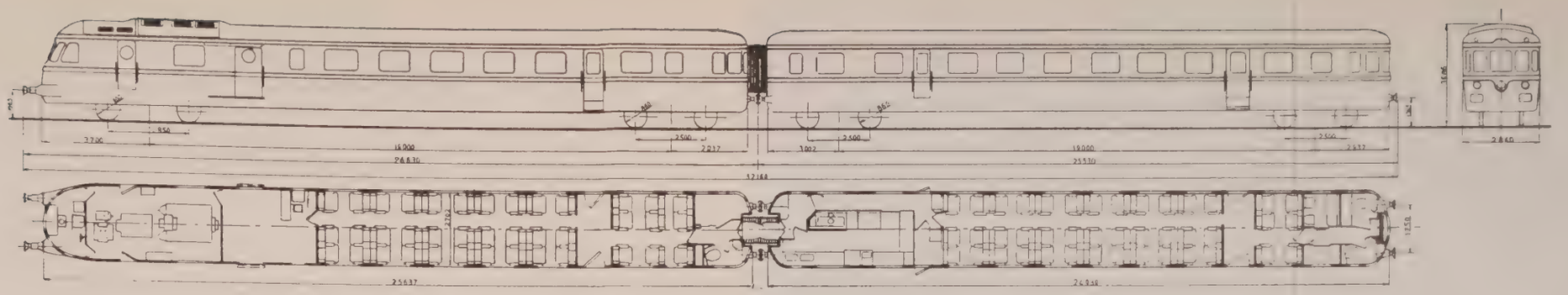
Trans-Europ Express » (3rd Group).

Italian State Railways	*Netherlands Railways*
TEE	TEE
2 motor units	1 mot. unit + 2 trailers + 1 trailer w. driving compartment **
gangway with bellows	gangway with bellows
140	140
490	2 × 1 000
	5
not indicated*	10
	5
Yes	No
on main and secondary lines in passenger traffic in luxury train in long distance express services	on main lines in passenger traffic in luxury train in long distance express services
42 + 48 = 90	8 for the customs
—	1st class : 72
—	1st class : 42
8	7.5
14.8	Rest. and bar : 30 Customs : 4.5 Staff : 5.7
9 (weight of the rake)	110
—	37.5
—	36
1 500	1 500
10.2	9
—	0.05
—	110
—	60
90 000	
120 000	
360 000	
500 000	
12	no experience
—	
—	

ing compartment, 26. ** Identical to RAm rake of the Swiss Federal Railways.

Fig. 28. — *F.S.* : Double TEE rake with hydraulic drive. 2 × 490 HP - 140 km/h.
(See Table 4*c* and diagram, fig. 31.)

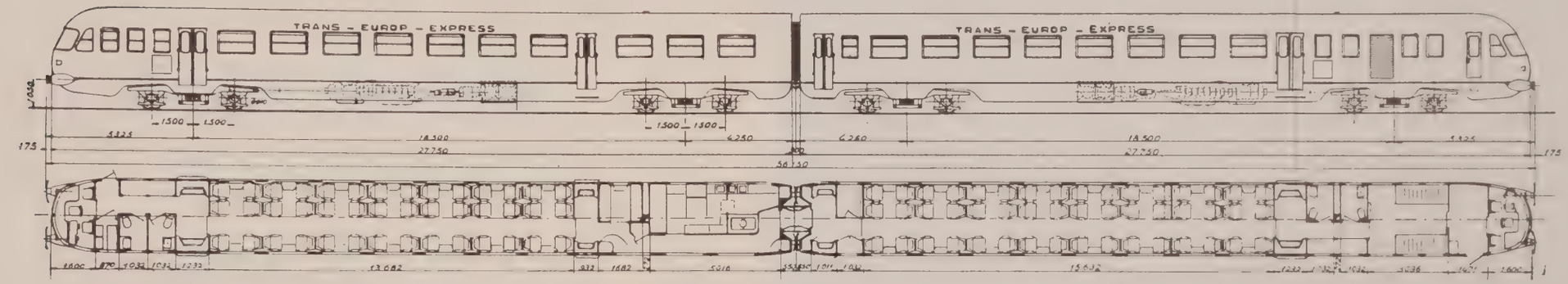
Fig. 29. — *N.S.* : For unit TEE rake with electric drive. 2 × 1 000 HP - 140 km/h.



GENERAL CHARACTERISTICS :

Main use	International services.	Radius of action	1 750 km.
Number and power of engines	1 × 825 HP.	Total weight (tare)	78.5 t } Weight per
Drive	Hydromechanical.	Total number of seats	81 } seat 969.1 kg.
Maximum speed	140 km/h.	Diesel engine in the body.	

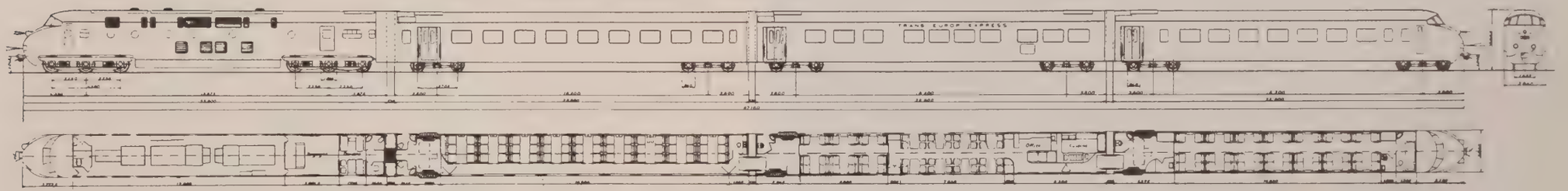
Fig. 30. — *French National Railways :* Double TEE rake (1 motor unit). Year of construction : 1956.



GENERAL CHARACTERISTICS :

Main use	International services.	Radius of action	1 500 km.
Number and power of engines	2 × 490 HP.	Total weight (tare)	96 t } Weight per
Drive	Hydromechanical.	Total number of seats	90 } seat 1 066.6 kg.
Maximum speed	140 km/h.	Diesel engines fastened under the body.	

Fig. 31. — *Italian State Railways :* Double TEE rake (2 motor units). Year of construction : 1957.



GENERAL CHARACTERISTICS :

Main use	International services.	Total weight (tare)	221 t } Weight per
Number and power of engines	2 × 1 000 HP.	Total number of seats	114 } seat 1 938.5 kg.
Drive	Electric.	Diesel engine in the body. Stone/Carrier air conditioning.	
Maximum speed	140 km/h.	(9 000 frigories/hour/coach. Heating power 30 000 kcal/hour/	
Radius of action	1 500 km.	trailer).	

Fig. 32. — *Netherlands Railways :* Four unit TEE rake (1 motor unit + 2 trailers + trailer with driving compartment). Year of construction : 1957.

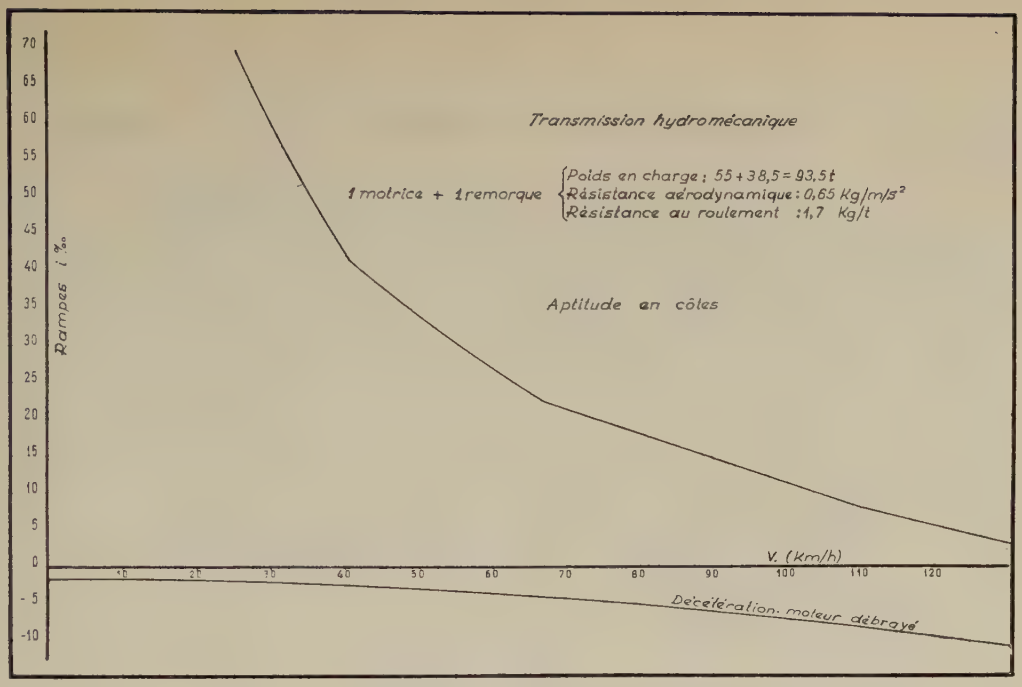

Transmission hydromécanique
1 motrice + 1 remorque
Poids en charge : 55 + 38,5 = 93,5 t
Résistance aérodynamique : 0,65 Kg/m/s²
Résistance au roulement : 1,7 Kg/t
Aptitude en côtes
Rampes i ‰
V. (Km/h)
Décélération moteur débrayé

Fig. 33. — *S.N.C.F.* : TRANS-EUROP EXPRESS units. Performance on gradients.

Explanation of French wording :

Transmission hydromécanique = hydromechanical drive. — 1 motrice + 1 remorque = 1 motor unit + 1 trailer. — Poids en charge = weight loaded. — Résistance aérodynamique = aerodynamic resistance. — Résistance au roulement = running resistance. — Aptitude en côtes = performance on gradients. — Décélération moteur débrayé = deceleration with motor out of gear. — Rampes = gradients.

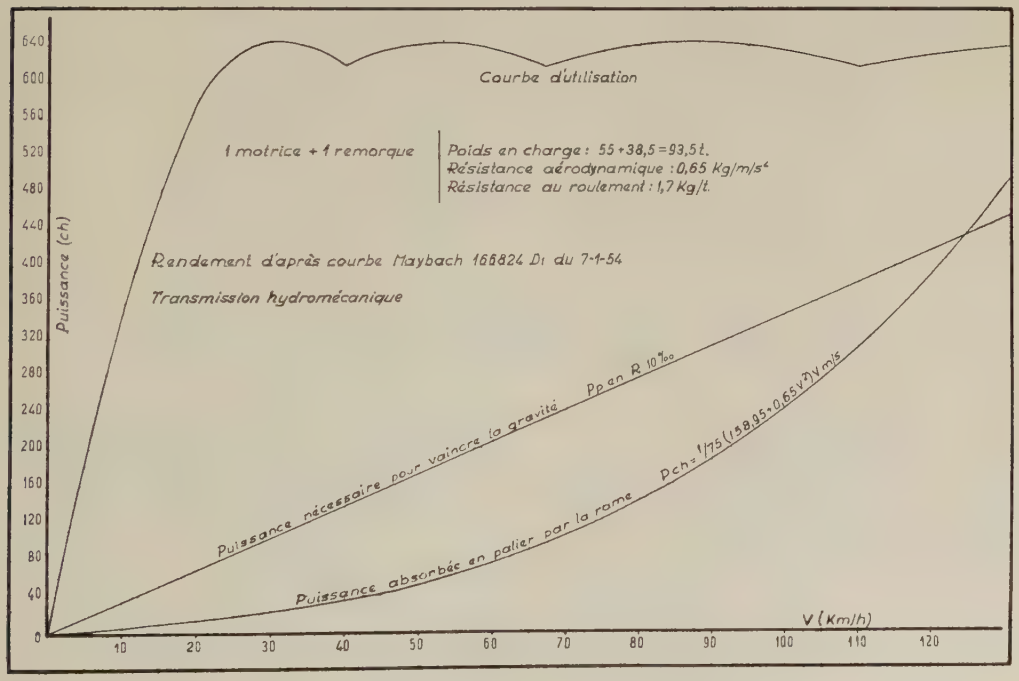
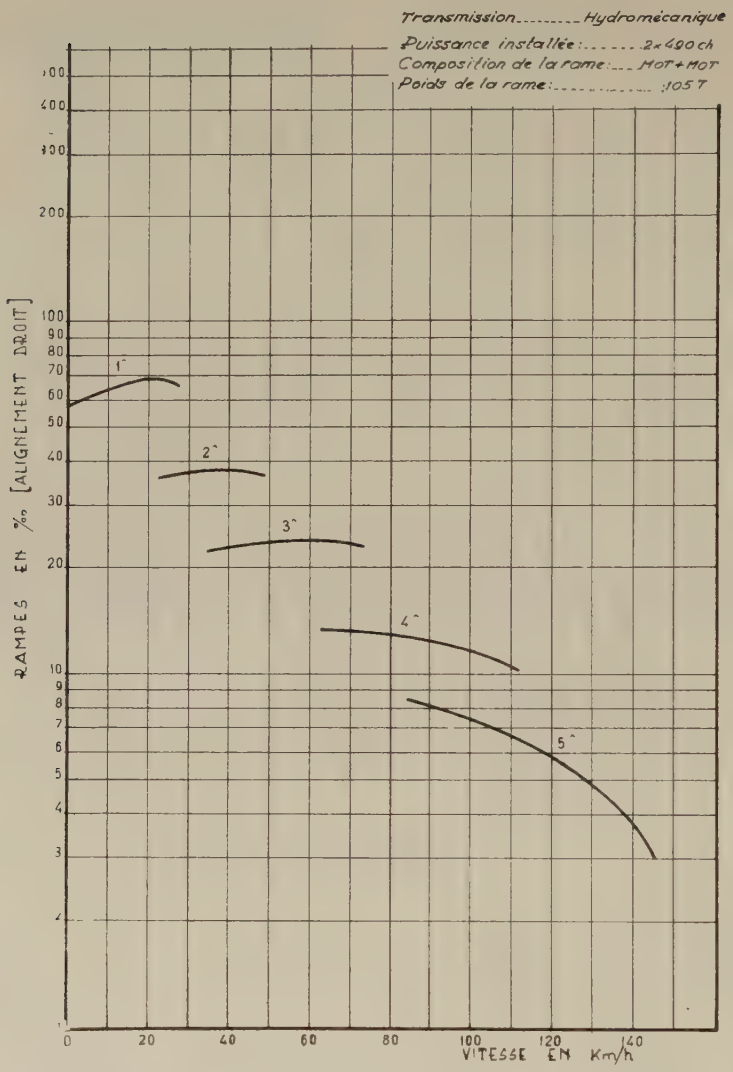

Courbe d'utilisation
1 motrice + 1 remorque
Poids en charge : 55 + 38,5 = 93,5 t.
Résistance aérodynamique : 0,65 Kg/m/s⁴
Résistance au roulement : 1,7 Kg/t.
Rendement d'après courbe Maybach 166824 Di du 7-1-54
Transmission hydromécanique
Puissance (ch)
Puissance nécessaire pour vaincre la gravité Pp en R 10 ‰
Puissance absorbée en palier par la rame Pch = 1/75 (158,95 + 0,65 V²) V m/s
V (Km/h)

Fig. 34. — *S.N.C.F.* : TRANS-EUROP-EXPRESS units. MGO engine, 825 HP Auxilaries 48 HP.

Courbe d'utilisation = Utilisation curve. — 1 motrice + 1 remorque = 1 motor unit + 1 trailer. — Poids en charge = weight loaded. — Résistance aérodynamique = aerodynamic resistance. — Résistance au roulement = running resistance. — Rendement d'après courbe Maybach = output according to Maybach curve. — Transmission hydromécanique = Hydromechanical drive. — Puissance nécessaire pour vaincre la gravité = power required to overcome gravity. — Puissance absorbée en palier par la rame = power absorbed on the level by the rake. — Puissance (ch) = power (HP).



Transmission	Hydromechanical.
Power installed	2 × 490 HP.
Composition of the rake	MOT + MOT
Weight of the rake	105 t.

Fig. 35. — *F.S.* : Double TEE rake. Performance on gradients.

Explanation of French wording :

Transmission - hydromécanique = hydromechanical - transmission. — Puissance installée = power installed. — Composition de la rame = composition of the rake. — Poids de la rame = weight of the rake.

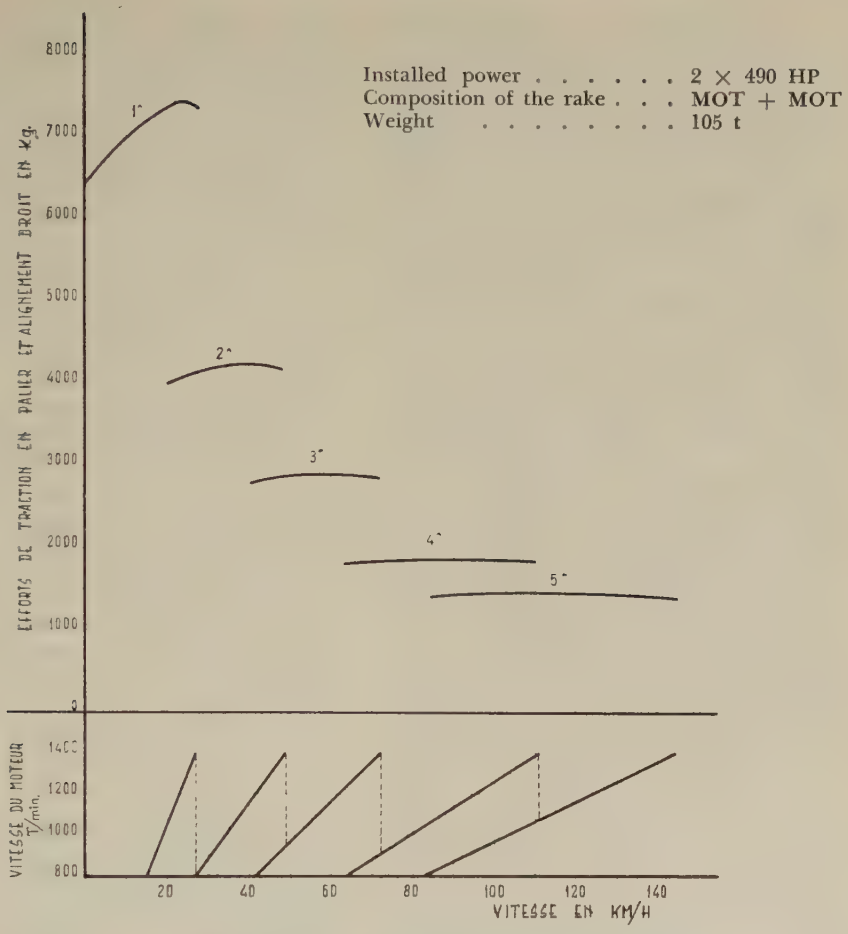


Fig. 36. — *F.S. :* TEE double rake. Traction pull in relation to speed.

Explanation of French wording :

Efforts de traction en palier et alignement droit en kg = traction effort on level and on the straight in kg. — Vitesse du moteur = engine speed. — Vitesse en km/h = speed in km/h.

II. IDEAS AND OPINIONS OF THE ADMINISTRATIONS CONCERNING THE DESIGN AND IMPROVEMENT OF RAILCARS.

A. Object of using railcars.

With only a few exceptions, railcars are used exclusively for passenger services, in order to obtain a more economical service in the many cases where the amount of traffic does not justify running trains hauled by a locomotive. In such a case, railcars — consisting of one, two, three, or at the most, four units, one or two of which can be trailers — have replaced steam traction, in particular for the following reasons :

— Lower cost (savings on staff, fuel and general depot costs);

— Greater flexibility in working, making it possible for the same outlay to improve the services by running them more frequently, it being possible to make up bigger rakes running as multiple units;

— Better performances in particular speeding up the stopping and semi-direct trains;

— Stimulating clients (Faster and more pleasant services than with steam traction).

Railcars work : on certain railways, nearly all the stopping services (except in the suburbs of large cities); connecting services with electrified lines; direct and semi-direct services over average and long distances, when the importance of the traffic does not justify the introduction of trains (certain services on main lines that have not yet been electrified, or services on main, secondary or narrow gauge lines with little traffic). On certain services where there is very little traffic, it is now preferable to use buses for the transport of passengers.

Mention must also be made of the possibility of carrying railcars on ferry-boats.

In addition, as railcars have a higher unit power than steam or diesel locomotives and on many lines are allowed to run at higher speeds than the trains (generally because of their low axle loads and low centre of gravity), they have higher average speeds than the trains.

Railcars are however only economic for moderate capacities. In addition, taking into account dieselisation of the traffic on the non-electrified lines, diesel locomotives are necessary in any case to haul the freight trains and heavy passenger trains (workmen's) particularly in the morning and evening. It is not possible, for example, to replace heavy trains by railcars at the rush hours.

In order to assure as intensive a user of these locomotives as possible, they should be used during the slack hours to haul trains which have a lower user, rather than purchase additional railcars for this purpose, the passenger coaches required being usually available also at these hours, and thus being better used.

To sum up, the system of traction will be chosen in such a way as to meet operating requirements, whilst keeping to the minimum the total capital invested in the rolling stock.

The replacement of railcar services by trains during momentary peak traffic, is a question the solution of which depends on local circumstances and on what stock is available.

The S.N.C.F. considers that it is costly to replace railcar services by trains, and is of the opinion that such a measure should be avoided, which moreover becomes everyday more difficult owing to the reduction in the number of locomotives, consequent upon the development of electrification and diesel traction. This Administration therefore considers it is necessary to make use of railcars having a considerable reserve of power so that they can be run with trailers.

The opposite operation — replacing a heavy train by numerous railcar services — has not generally been considered by the Administrations.

The S.N.C.B., the Ö.B.B. and the F.S. consider in principle that it is more economic to haul a heavy train by a diesel locomotive than to multiply the railcar services.

Such a multiplication of the services is moreover limited by operating possibilities, especially on single lines.

The use of high speed large capacity railcars running as multiple units with trailers (centralised control) does not seem to be markedly preferred by the Administrations for ordinary services. As the Luxemburg Railways point out, such a use of them depends on the one hand on the characteristics of the passenger traffic (possibility of a rational use of the trailers and installed power of the railcars), and on the other hand, on maintenance costs.

The S.N.C.F. states that it has not made a great use of the control of multiple units, in order to avoid to complicate the equipment; in trains consisting of several railcars, these are coupled together in pairs, i.e. each driven by a driver who gets the necessary orders by means of acoustic signals from the driver of the leading unit (brake operated by this driver only).

The S.N.C.B., on its part, also states that it has not used fast railcars with a high transport capacity running as multiple units with trailers for long distance services, owing to the small extent of its system and the electrification of the most important lines.

On the non-electrified lines, on the other hand, this Administration makes use of simple railcars of large capacity (140 seats) for the stopping and semi-direct services, which can run at maximum speeds of 80 or 90 km/h and can be coupled up to and run with trailers.

The composition of the rakes formed in this way may be up to two railcars and two trailers (about 450 seats) driven by one man, which leads to great flexibility of working.

A similar solution has been used on the Danish Railways: on this system, the composition of the trains which consist of railcars hauling ordinary coaches, can be adapted to the season and hour of the day.

The Royal Cambodian Railways consider it valuable to make use of large capacity railcars running with trailers, so as to cover all or nearly all the passenger traffic, thus leaving steam traction for the freight traffic.

The Portuguese Railways consider it advisable to use high capacity railcars on condition that the rake does not consist of more than two motor units. Beyond this limit, they prefer trains hauled by diesel locomotives for economic and technical reasons.

* * *

B. Standardisation of railcars.

In general, all the Administrations are considering using in the future a smaller number of types of railcars than at the present time.

The S.N.C.F. since 1948 has reduced the types of railcars it is building to 4 for regional services, and 2 for the long distance express services.

On the S.N.C.B., in future, the railcars will all be simple bogie railcars, double, or if needs be, triple.

On the other hand, the Railways are trying to use a smaller number of types of engines and drives.

However, constructional arrangements or standards, which would make complete interchangeability of the equipment possible have not been stipulated, or recognised as possible or even desirable by all the Railways unanimously.

The general tendency is towards standardisation limited to certain equipment: compressors, heating and ventilating equipment, body and bogie components, etc.

* * *

C. Improvement of railcars.

We consider it advisable to preceed our report of the ideas and opinions of the Administrations regarding the questions analysed below by a brief description of the technique of construction or arrangements adopted in this connection in the case of railcars built between 1st January 1946 and 1st January 1957 (railcars considered under C in the Introduction).

1. Motor equipment.

(motor, transmission and drive).

Arrangements adopted for the motor and transmission. — The most important information supplied by the Administrations regarding the engines used in the

railcars dealt with above have been collected together in Table 5. To complete this information, we have included a certain number of photographs (fig. 37-38) and characteristic engine curves (fig. 39 to 41).

An anlysis of the Table 5 shows that the engines described are usually four stroke engines, with water cooling, and that about 37 % are supercharged.

The principles of regulation by adjusting the feed and by combining the control of the speed and the feed are those most generally used.

According to the data relating to the railcars given in Tables 4*a*, 4*b* and 4*c*, in 60 % of the cases, there is only one engine per motor unit.

We give below the arrangements adopted for the engine and drive on a certain number of railcars.

Railcars 5 080 of the Ö.B.B. for stopping services (Table 4*a*) :

engine :

— 280 HP — 1 500 r.p.m. — not supercharged (Table 5) suspended under the body, on a special frame. (The body rests by means of springs on this frame which takes all the motor equipment);

drive :

— mechanical (on the frame mentioned above) — number of speeds, 5 — gear change by hand;

connection between engine and drive :

— elastic cardan shaft (mechanical coupling);

driving of motor axles :

— a single axle is driven by cardan shaft and conical gear wheels;

(efficiency curves for the drive, some utilisation and drive factors as a function of the running speed, are given in figure 42).

Railcars 604 for current services on the S.N.C.B. (Table 4*a*) :

engine :

— 356 HP — 1 800 r.p.m. — two stroke — on sub frame suspended under the body to the main frame by suspension rods;

drive :

— hydromechanical (on the same frame as the engine) number of speeds, 2 (convertor) + direct drive — change of speed, by hand — disc clutch operated by oil pressure from an electro-pneumatically controlled distributor from the controller in the driving compartment;

connection between engine and drive :

— elastic coupling (rubber discs);

driving of motor axles :

— two axle bridges with conical gears and a differential with reduction by a pair of straight gears;

factor of utilisation of the power installed :

— full power at torque convertor, power corresponding to the speed in direct drive;

(curves of the speed of the engine and efficiency of the drive as a function of the running speed given in figure 43).

All purpose railcars X 2.800 of the S.N.C.F. (Table 4*a*) :

engine :

— 825 HP — 1 500 r.p.m. — 4 stroke — supercharged in the body;

drive :

— hydromechanical — in the body on a special auxiliary frame — number of gear speeds, 4 — automatic gear change as a function of the ratio between the secondary and primary speeds — declutching of the turbine, change of speeds and synchronisation of the different components to be coupled by claw couplings of the Maybach system;

connection between engine and drive :
— cardan shaft;

driving of motor axles :
— set of straight gears;

(torque and output curves given in figure 44).

Railcars VT 5.045 + VS 6.545 for Ö.B.B. express services :

engine :
— 500 HP — 1 360 r.p.m. — 4 stroke — supercharged — on bogie;

drive :
— hydraulic (VOITH, type T 26/500, with two torque convertors, working one after the other), on a bogie — continuous speed variation — automatic change of speed by refilling the circuits;

connection between engine and drive :
— elastic cardan shaft (mechanical coupling);

driving of motor axles :
— conical sets of gears with differential between the hydraulic system and the cardan shafts driving the axles;

(efficiency curves for the drive and the transmission factor as a function of the speed of running are given in figure 45).

TEE rake (1 motor + 1 trailer) of the S.N.C.F. (Table 4*c*) :

engine :
— 825 HP — 1 500 r.p.m. — 4 stroke — supercharged — in the body, on a special frame — temperature of the cooling water on leaving the engine 95° C (Table 5);

drive :
— hydromechanical, in the body on a special auxiliary frame; number of speeds 4 — change of speed, automatic, as a function of the ratio between the secondary and primary speeds — declutching turbine of the passage from one speed to another and synchronisation of the components connected together by claw couplings of the Maybach system;
— speed at entry of the transmission . . . . . 1 500 r.p.m.
— speed of primary shaft of convertor . . . . 2 925 r.p.m.
— maximum outlet speed or transmission . . . 1 600 r.p.m.
— multiplication ratio of the transmission to the axle 0.442
— maximum temperature of the oil in the convertor . . . . . 200° C
— evacuation of the heat by artificial ventilation by exchanger (common cooling with that of the engine oil and cooling water);

connection between engine and drive :
— elastic cardan shaft (mechanical coupling);

driving of motor axles :
— cardan shaft without differential;

(torque and efficiency curves given in figure 44).

TEE rake (1 motor + 2 trailers + trailer with driving compartment) of the N.S. (Table 4*c*) :

engines :
— 2 × 1 000 HP — 1 400 r.p.m. — supercharged (Table 5) — in the body;

drive :
— electric (BBC system) — generator in the body — traction motors on the bogies;

connection between engine and drive :
— generator mounted directly on the engine (mechanical coupling);

generator :
— direct current, maximum voltage 700 V — regulation of the field by servo-motor;

traction motors :
— maximum speed, 2 300 r.p.m.;

principle of regulation :

— precise regulation of the speed by 7 notches — regulation of feed at fixed point for each speed — regulation of the field of the generator according to the feed;

driving of motor axles :

— individual axle drive — rigid suspension of motor — BBC elastic gears — straight set of gear wheels — reduction ratio of traction motors to the axle 23 : 72;

cutting in speeds of the transmission as a function of the running speed for the different running notches :

Running notches.	Diesel-generator group r. p. m.
1	800
2	900
3	1 000
4	1 100
5	1 200
6	1 300
7	1 400
8	1 400

weakening of the field of the traction motors.

(remote electric control of the speed of the diesel engines and field of the traction motors (last notch); automatic control of the field of the generator).

TEE rake (1 motor + 1 motor) of the F.S. (Table 4*c*) :

engines :

— 2 × 490 HP — 1 500 r.p.m. — supercharged — suspended under the body (Table 5);

drive :

— hydraulic (hydraulic coupling and mechanical gear box, Wilson type — under the body — number of speeds, 5 — change of speed, automatic);

connection between the diesel engine and the transmisison :

— cardan shaft and hydro-dynamic coupling;

driving of motor axles :

— individual drive through springs (hollow shaft) — conical set of gears with helicoidal teeth, Gleason type (the system of drive includes the transmission shaft, the main reduction gear, the secondary reduction gear and a hollow shaft, and transmits the movement of the wheels through rubber blocks arranged radially on the wheels (fig. 46).

The driving axles are the axles of the outer end bogies of the rake (fig. 47 and 48).

Ideas and opinions of the Administrations.

Choice of number and type of engines. — Except in a few special cases, the Administrations stipulate almost unanimously the use of a single engine per railcar rather than two engines of lesser power.

They consider that having two engines involves an appreciable increase in maintenance costs, owing to the important part paid by labour costs therein, and on the other hand, the installation of two engines does not appreciably increase regularity of working, the two engined railcar being rarely able to continue working with one engine damaged. Trouble in working and breakdowns are frequently caused by the auxiliaries or control and driving gear, which are naturally more numerous and more complicated when there are two engines.

As the reliability of working of up-to-date engines is extremely good, the solution of a single engine does not affect regularity of working, and appears to be the simplest and most economic solution.

The S.N.C.F. considers that the percentage of breakdowns of railcars with a

single engine is lower than that relative to steam and electric traction.

There are however special cases in which the solution of two engines can be justified.

The Jugoslavian Railways stipulate this solution in the case of the most powerful units, and the S.N.C.B. considers it when there is no sufficiently powerful engine available which could be adapted for the proposed service, or again when in the case of a limited series of railcars, they do not wish to introduce a new type of engine but to use engines already adopted for other railcars, or built in series for other designs. The F.S. expressed a similar opinion.

Again almost unanimously, the Railways prefer fast running engines (at least 1 350 r.p.m.) for railcars on account of the restrictions on weight and size.

The 4 stroke engine, whether supercharged or not, is unanimously preferred by the Administrations, which consider it to be less delicate and more economic than the 2 stroke.

On certain railcars, however, reasons in connection with the weight and size have justified the use of 2 stroke engines, but such cases are becoming more and more rare owing to the progress made in the supercharging of 4 stroke engines.

Siting and suspension of the engine. — The engines can be installed on the railcars on the bogies, under the floor or in the body.

The arrangement preferred differs, naturally, according to the conditions on each Railway, and the importance attributed by the Administrations to the advantages and drawbacks of each of the possible solutions.

However, in general, it is to be noted that in the case of powers not exceeding some 500 HP, the engines are mounted under the floor or on the bogies, the first of these two solutions together with the use of horizontal engines being preferred by most Railways.

In the case of higher powers — for example in the case of railcars for long runs and high class (multiple rakes) — the installation of the engines in the body is stipulated, as a result of the experience acquired by a certain number of the Administrations.

Installing the engines on the bogies has the advantage of reducing the transmission of vibrations to the body and of making it possible to replace the engines quickly and easily by replacing the whole motor bogies.

Against these advantages, there are the following drawbacks to be taken into account : the difficulty of getting sufficient airtightness between the engines and the body, which results in a possibility of dust penetrating into the engine compartment; the need to make use of connections by flexible cables between the engine and the body for the cooling water and fuel, as well as a telescopic connection between the diesel engine exhaust and the chimney; facts likely to involve wear and a lack of airtightness; the difficulty of obtaining high quality running owing to the excessive non-suspended weight; more complicated bogie construction, with less accessibility, defects which increase as the power becomes greater.

In favour of siting the engine under the floor is the advantage of not having to sacrifice any floor space to house the motor equipment.

With such a design, however, as well as in the case when it is mounted in the body, it is necessary to provide a suspension for the engines which will effectively damp out the vibrations and very careful soundproofing of the body.

As we have already said, the installation of a single engine per railcar is the solution preferred by the Administrations for reasons of simplicity and economy. However, when it is question of engines of relatively high power, installing it under the floor is a complicated and costly matter and involves considerable care in the design (floor raised up in particular).

It is on account of these drawbacks that in the case of high powers, siting the engine in the body is the solution preferred by a certain number of Railways. In addition, it is considered that owing to the frequent use of trailers in the case of high powers, the reduction in the capacity due to the engine being above the floor is relatively unimportant.

Treatment of the engine cooling water. — In general, the Railways use treated water in the engine cooling circuits, according to various criteria.

On the S.N.C.B., the water available is never used without preliminary external treatment to fill up the diesel cooling circuits unless it is neither too hard (maximum 15 French degrees) nor too corrosive (maximum 150 g of chlorides). If not, this Railway uses town water which has been softened to 1/2 French degree by preliminary external treatment (permutation).

In every case, the water is treated in the cooling circuit to prevent corrosion (internal treatment). So far, the products used have a chromate base (Nalco 38 or similar).

In view of the drawbacks to chromates (their incompatibility with anti-freeze products, risk of dermatitis for the staff) trials are in hand on the S.N.C.B. with products having a borate base (Nalco 39 or similar). The same product Nalco 39 is used by the Danish Railways.

In Luxemburg, the water is treated with a product having a sodium chromate base (RD 8).

On the S.N.C.F., in the case of engines used under conditions which make it unnecessary to use anti-freeze products, the water is treated with chromate (270 g of caustic soda and 920 g of sodium bichromate per 1 000 l of water).

In the case of engines where anti-freeze products have to be used, the water is treated with benzoate-nitrite of sodium (15 kg of benzoate nitric and 1 kg of nitrite of sodium per 1 000 l of water). This method costs more than the former one.

The Portuguese Railways use treated water (Dearborne 517) solely in engines whose power is equal to or above 500 HP.

The table hereafter sums up the replies received from the Administrations as regards this problem.

Choice of the system of transmission. — The opinions of the Administrations are not altogether unanimous on this point.

We have shown in figure 49, as a function of the power of the railcars, the field of user of the different systems of drive according to the opinions expressed by the Administrations.

It will be noted that in the case of railcars whose power does not exceed 300 HP, the Railways generally prefer mechanical drives, whilst in the case of higher powers, opinions are divided between the hydraulic and the electric drive.

In the case of high powers, the advantages claimed for the hydraulic drive (hydro-dynamic type) are the following :

a) compared with mechanical drives :
- — ease of driving (modern hydraulic drives require no action on the part of the driver when changing speed or circuits) ;
- — lower purchase price when compared with mechanical drives with gears always in mesh and hydraulic coupler necessary in the case of rather higher powers;
- — full use of the available power of the diesel, at least in the zones of working under torque conversion;
- — continuity of the traction effort;
- — great facility of control in the case of multiple units.

b) compared with electric drives :
- — lower purchase price;
- — less weight for size;
- — possibility of reducing the non-suspended weight.

Administration	*Water used*	*Remarks*
S.N.C.B.	Water treated with Nalco 38 or some such product	Trials in hand with Nalco 39 or similar products.
Denmark	Water treated with Nalco 39.	
S.N.C.F.	Water treated with chromate or	Without anti-freeze.
	Water treated with benzoate-nitrite of NA . . .	With anti-freeze.
Luxemburg	Water treated with a chromate Na base.	
C.F.P.	Water treated with Dearborne 517*	* Power : $\geqslant$ 500 HP.
F.S.	Water only treated in certain types of engines (Nalco 39 and Disckro TS 10)	Ordinary water in all other cases.
Togo	Water only treated when pH $<$ 7.	
Algeria	Water treated with Zerhyd. Anana water softener.	
N.S.	Untreated water (with antifreeze in winter).	
Jugoslavia	Untreated water.	
Poland	Untreated water,	
Ö.B.B.	Untreated water **	** Trials are in hand with Cepi magnetic equipment.
Cambodia	Untreated water.	

In the case of modern hydraulic drives, it is considered that the slight differences in output in favour of the electric drive play no essential part owing, in particular, to the relatively small importance of fuel costs in the overall cost of a railcar.

On the other hand, the Administrations who favour the electric drive, put forward the following argument for using it :
— simplicity of driving;
— regularity of working;
— simple and economic maintenance;

circumstances, which in their opinion, make up for the weight, and eventually the high cost of electric drives.

Although the S.N.C.F. prefer the hydraulic drive for railcars of more than 500 HP, they have chosen for their so-called « panoramic » 800 HP railcars, now under construction, an electric drive because of its ease of installation.

It should be noted however that no Administration has mentioned the carrying out of systematic trials of different drives of the same power in identical railcars, which would make it possible to establish an accurate comparison of maintenance and repair costs for mechanical, hydraulic and electric drives.

It is easy to appreciate how difficult and complicated such trials would be.

The siting of the mechanical or hydraulic gearbox is in general linked up with the position selected for the diesel engine.

The axles are usually driven by means of cardan shafts and axle bridges which usually include a set of conical gears and in the case of low powers a worm.

Conical gears with helicoidal teeth, which are quieter, are preferred by certain Railways.

Use of light metals for the transmission. — As regards the use of light metals in the construction of the transmissions, the S.N.C.F. reports that it has not encountered any special difficulties with the great many 300 HP drives which have light alloy gearcasings (engine gearcases excepted).

The S.N.C.B., in its turn, states that it has had in service since 1939 mechanical boxes (SLM Winterthur) and hydraulic boxes (VOITH) with aluminium alloy gearboxes which have not undergone any deformation likely to give rise to any difficulties whatsoever.

Electric transmissions. — No new types or new designs of regulation were reported by the Railways in connection with electric drives.

As far as the system of suspension of the traction motors is concerned, most Railways using electric drives on railcars consider the nose suspension which is very often adopted to be satisfactory.

The Netherlands Railways also consider it satisfactory up to 125 km/h, but think that elastic suspension is better and have used this latter type in the TEE railcars.

On the DE 1 and DE 2 railcars, this Railway uses a type of suspension with which the shaft of the traction motor is parallel to the axis of the coach, the drive being by means of cardan shaft.

This arrangement, which is also used on certain of the C.F.P. railcars has proved satisfactory so far. Stability tests on the railcars whilst running to measure the stresses between wheel and rail with nose suspended engine and elastic suspension of the engine have not been carried out by the Railways.

Drive. — Most of the Railways stipulate having two driving compartments on railcars, one at each end, for the sake of good visibility.

However, on certain small short railcars, some Railways prefer to have only one driving compartment which is raised up at one end, or a driving compartment in the centre in a side compartment.

No Administration reports having made any special studies for the improvement or simplification of the classic designs aopted for multiple control from one driving compartment.

The use of safety devices to prevent the diesel running at too high a speed when running down gradients has only been mentioned by the S.N.C.B. and the F.S.:

— the engines of the S.N.C.B. railcars with hydraulic transmission (with coupler in the final stage) or hydromechanical drives of recent design (types 603, 604, 605) are fitted with a overspeed regulator acting by centrifugal force, inde-

pendent of the main regulator, which cuts the injection of fuel and throws the transmission out of gear if the excess speed becomes dangerous; for this purpose, a regulator acts on an electric contact fitted in the circuit of the main control electrovalve of the engine. On the recent TEE railcars of the F.S., a safety device of this type is coupled up with the automatic gear change.

* * *

Railcar engines.

— Descriptive Table 5;

— Photographs (fig. 37-38);

— Characteristic curves (fig. 39 to 41).

TABLE 5. — Types of eng

Owner Administration :	*Austrian Federal Railways* (VT 5045) (VT 5046)
Type	S 12a
Maker	Simmering - Graz - Pauker A.G., Wien
Nominal power in HP	500 (at 1 360 r.p.m.)
2 stroke / 4 stroke Horizontal / vertical / in V	4 stroke —
Average speed of the piston at nominal speed in m/sec	13.5
System of supercharging	Exhaust gases turbo-compressor
Supercharge air pressure at full load in kg/cm²	1.3
Increase in the power compared with non-surcharged engine in %	32
System of cooling the engine	By water
System of dissipating the heat in the engine lubricating oil	Cooling water for the engine (heat exchanger)
Weight of diesel engine (without lubricating oil) in kg	4 200
Ratio $\frac{\text{weight}}{\text{HP}}$ in kg	8.4
Temperature of exhaust gases at full load and nominal speed : — at the collar of the exhaust collector	480° C (place where temperature was measured not stated
— at the entry to the turbo-compressor	—
Lubrication by lubricating oil with additions or without additions	Without additions
Viscosity in SAE	30 (to 50° C)
Special safety devices : against excess speed against insufficient oil pressure against insufficient water left against excessive water temperature against insufficient oil pressure on starting against other factors not mentioned above	Speed regulator and indicator * Light signal and audible warning * Water level gauge and audible warning * Temperature indicator and audible warning * Light signal * Manual lubricating pump —
Principle of regulation	Combined regulation of the speed and feed
Filters on the engine for :	Air : 3 - Lubricating oil : 1 - Fuel oil : 2

* In driving compartment.

ısed in Diesel railcars.

Austrian Federal Railways — (VT 5080)	*Belgian National Railways* (554)
S 8 B	8 D 120 B
Simmering — Graz — Pauker A.G., Wien	S.A. Brossel Fr., Brussels
280 (at 1 500 r.p.m.)	166 (at 1 800 r.p.m.)
— —	4 stroke —
14.9	9
—	—
—	—
—	—
By water	By water
Cooling water for the engine (heat exchanger)	Natural cooling under the gearbox of engine
2 500	1 500
8.9	9
480° C (place where temperature was measured not stated)	—
—	—
Without additions	With additions
30 (at 50° C)	30
Speed regulator and indicator * Light signal and audible warning * Water level gauge and audible warning * Temperature indicator and audible warning * Light signal *	Bosch regulator with maximum and minimum Check light — — — —
Regulation of feed	Regulation of feed
Air : 4 - Lubricating oil : 1 - Fuel oil : 1	Air : 3 - Lubricating oil : 1 - Fuel oil : 1

TABLE 5. — Types of engi

Owner Administration :	*Belgian National Railways* (603)
Type	6 K 103 H
Maker	S E M at Gand
Nominal power in HP	400 (at 1 350 r.p.m.)
2 stroke / 4 stroke Horizontal / vertical / in V	— —
Average speed of the piston at nominal speed in m/sec	10.8
System of supercharging	Exhaust gases turbo-compressor
Supercharge air pressure at full load in kg/cm²	1.4
Increase in the power compared with non-supercharged engine in %	25
System of cooling the engine	By water
System of dissipating the heat in the engine lubricating oil	By the engine cooling water
Weight of diesel engine (without lubricating oil) in kg	3 500
Ratio $\frac{\text{weight}}{\text{HP}}$ in kg	8.7
Temperature of exhaust gases at full load and nominal speed : — at the collar of the exhaust collector	575° C (place where temperature was taken not indicated)
— at the entry to the turbo-compressor	—
Lubrication by lubricating oil with additions or without additions	With additions
Viscosity in SAE	40 (to 20° C)
Special safety devices : against excess speed	Centrifugal force regulator cutting the fuel injection
against insufficient oil pressure	Oil pressure relays which stop the engine
against insufficient water left	—
against excessive water temperature	—
against insufficient oil pressure on starting	—
against other factors not mentioned above	—
Principle of regulation	Regulation of the feed
Filters on the engine for :	Air : 1 - Lubricating oil : 1 - Fuel oil : 1

* Including 2 × 6 injector filters.

ed in Diesel railcars *(continued)*.

Belgian National Railways (604)	*Belgian National Railways* (605)
Twin 6-71 (model 12107)	6057 C – G.M. 6-71
General Motors	General Motors
356 (1 800 r.p.m.)	178 (at 1 800 r.p.m.)
2 stroke —	— —
7.62	7.62
—	—
—	—
—	—
By water	By water
By the engine cooling water (heat exchanger)	The engine cooling water (heat exchanger)
2 000	1 000 per engine
5.6	5.6
—	—
—	—
With additions	With additions
30	30
Centrifugal force regulator which stops the diesel and puts the transmission out of gear Oil pressure manocontactor which stops the diesel — — — —	Centrifugal force regulator which stops the diesel engine and puts the transmission out of gear Manocontact which stops the diesel engine — Water temperature relay which stops the diesel engine — Manocontact for lack of pressure in the fuel oil at entry to injection pumps
Regulation of the speed	Speed regulation
Air : 2 - Lubricating oil : 2 - Fuel oil : 16 *	Air 2 - Lubricating oil : 1 - Fuel oil : 8

Owner Administration :	*Danish State Railways*
Type	6185 CA
Maker	S/A Frichs, Arhus, Denmark
Nominal power in HP	250/275 (at 1 000 r.p.m.)
2 stroke / 4 stroke Horizontal / vertical / in V	— —
Average speed of the piston at nominal speed in m/sec	8.66
System of supercharging	—
Supercharge air pressure at full load in kg/cm²	—
Increase in the power compared with non-supercharged engine in %	—
System of cooling the engine	By water
System of dissipating the heat in the engine lubricating oil	System of cooling by air without special fan
Weight of diesel engine (without lubricating oil) in kg	2 550
Ratio $\frac{\text{weight}}{\text{HP}}$ in kg	9.2
Temperature of exhaust gases at full load and nominal speed : — at the collar of the exhaust collector — at the entry to the turbo-compressor	 Approx 310°C (place where temper. was measured not state —
Lubrication by lubricating oil with additions or without additions	With additions (experimentally) — without additions
Viscosity in SAE	30 (to 20° C)
Special safety devices : against corrosion against pitting against erosion against excess speed against insufficient oil pressure against excessive oil temperature against insufficient water pressure against insufficient water reserve against excessive water temperature against insufficient oil pressure on starting against too low water temperature on starting against other factors not mentioned above	 Nalco 39 — — Automatic closing of a wing nut in the admission pipe Device for regulating the oil pressure and light signal — Light signals — — Device for regulating the oil pressure — —
Principle of regulation	Combined regulation of the speed and feed
Filters on the engine for	Air 1 - Lubricating oil : 2 - Fuel oil : 2

used in Diesel railcars *(continued)*.

Danish State Railways	*Finnish State Railways* (Dm 7)
8185 CD	815 D (8 cylinders)
S/A Frichs, Arhus, Denmark	Valmet Oy Linnanvuoren tehdas
500 (at 1 000 r.p.m.)	180 (at 2 000 r.p.m.)
4 stroke —	4 stroke Vertical
8.66	8.7
Exhaust gases turbo-compressor	None
1.3	—
50	—
By water	By water
System of cooling by air without special fan	Cooling by air without fan
4 300	1 000
8.6	5.5
Approx 400° C (place where temper. was measured not stated)	450° C
—	—
With additions	With additions
30 (to 20° C)	Summer : 30 (to 20° C) — Winter : 20 (to 20° C)
Nalco 39 — — Automatic closing of a wing nut in the admission pipe Device for regulating the oil pressure and light signal — Light signals — — Device for regulating the oil pressure — —	Shell Dromus Oil B — — Speed regulator Pressure of lubricating oil cut out Thermometer — Level gauge Cut out — Preheating before departure —
Combined regulation of the speed and feed	Speed regulation
Air 1 - Lubricating oil : 3 - Fuel oil : 2	Air 1 - Lubricating oil : 1 - Fuel oil : 1

TABLE 5. — Types of engin

Owner Administration :	*French National Railways* (X 5500)
Type	BXDS-C
Maker	Saurer
Nominal power in HP	175 (at 1 600 r.p.m.)
2 stroke / 4 stroke Horizontal / vertical / in V	4 stroke —
Average speed of the piston at nominal speed in m/sec	9.6
System of supercharging	—
Supercharge air pressure at full load in kg/cm²	—
Increase in the power compared with non-supercharged engine in %	—
System of cooling the engine	By water
System of dissipating the heat in the engine lubricating oil	Engine cooling water (heat exchanger)
Weight of diesel engine (without lubricating oil) in kg	1 357
Ratio $\frac{\text{weight}}{\text{HP}}$ in kg	7.7
Temperature of exhaust gases at full load and nominal speed : — at the collar of the exhaust collector	450° C (place where temperature was measured not indicated)
— at the entry to the turbo-compressor	—
Lubrication by lubricating oil with additions or without additions	With additions
Viscosity in SAE	30 (to 20° C)
Special safety devices : against corrosion against pitting against erosion against excess speed against insufficient oil pressure against excessive oil temperature against insufficient water left against excessive water temperature against insufficient oil pressure on starting against too low water temperature on starting against other factors not mentioned above	— — — — — — — — — — —
Principle of regulation	Regulation of the speed (min. max.)
Filters on the engine for	Air 3 - Lubricating oil : 1 - Fuel oil : 1

sed in Diesel railcars *(continued)*.

French National Railways (X 2 800) (RGP) (TEE)	*French National Railways* (X 3 800)
M.G.O. V 12 SH	517–G
S.A.C.M.	R N U R
825 (at 1 500 r.p.m.)	300 (at 1 500 r.p.m.)
4 stroke —	4 stroke —
9/9.6	8.5/9
Exhaust gases turbo-compressor	—
1.58	—
—	—
By water	By water
By engine cooling water (heat exchanger)	By the engine cooling water (heat exchanger)
4 300	2 340
5.2	7.8
540° C (place where temperature was measured not indicated)	480° C (place where temperature was measured not indicated)
—	—
With additions	With additions
40 (to 20° C)	40 (to 20° C)
— — — — Manostat Thermostat Water level Thermostat Manostat Thermostat Discovery of a fire stops the group	— — — — — — — — — — —
Combined regulation of the speed and feed	Combined regulation of the speed and feed
Air : SACM 4 × 3 plates - Lubricating oil : Auto Klean 2 Fuel oil : 2 filters W 2 K 105	Air 3 - Lubricating oil : 1 - Fuel oil : 2

TABLE 5. — **Types of engi**

Owner Administration :	*French National Railways* (X 2400)
Type	BZDS-B
Maker	Saurer
Nominal power in HP	375 (at 1 600 r.p.m.)
2 stroke / 4 stroke Horizontal / vertical / in V	4 stroke —
Average speed of the piston at nominal speed in m/sec	9.6
System of supercharging	Exhaust gases turbo-compressor
Supercharge air pressure at full load in kg/cm²	1.58
Increase in the power compared with non-supercharged engine in %	—
System of cooling the engine	By water
System of dissipating the heat in the engine lubricating oil	By the engine cooling water (heat exchanger)
Weight of diesel engine (without lubricating oil) in kg	2 342
Ratio $\frac{\text{weight}}{\text{HP}}$ in kg	6.2
Temperature of exhaust gases at full load and nominal speed : — at the collar of the exhaust collector	480° C (place where temperature was measured not indicated
— at the entry to the turbo-compressor	—
Lubrication by lubricating oil with additions or without additions	With additions
Viscosity in SAE	30 (to 20° C)
Special safety devices : against corrosion against pitting against erosion against excess speed against insufficient oil pressure against excessive oil temperature against insufficient water left against excessive water temperature against insufficient oil pressure on starting against too low water temperature on starting against other factors not mentioned above	— — — — — — — — — — —
Principle of regulation	Speed regulation (min. max.)
Filters on the engine for	Air : 6 - Lubricating oil : 4 - Fuel oil : 2

ised in Diesel railcars *(continued)*.

Algerian Railways (YZZG) (type RT 6 MTJ)	*Algerian Railways* (Z Z N)
575	« B Z D S »
R N U R (Renault)	Saurer
360 (limited to 300 at 1 500 r.p.m.)	320 (at 1 500 r.p.m.)
4 stroke	4 stroke
—	—
8.5	—
—	—
—	—
—	—
By water and by SULZER electro-magnetic meter which regulates the cooling by stopping the fan	By water and by air
By the engine cooling water (heat exchanger) and pump	By the engine cooling water (heat exchanger) and pump
2 520	2 200
7	6.8
—	470° C (place where temperature was measured not stated)
—	—
—	Without additions
—	20 or 30 (at 50° C)
— — — Special device for putting engine out of gear Pressure gauge Thermometer Output and level indicator Thermostat Manostat Reheating by small heaters —	Water purified, filtered and treated with addition of RD 8 — — Excess speed limiter Pressure relay, pressure gauge, safety valve a. audible warn. Magnetic shutter, thermometer and audible warning « Watson » audible warning system Magnetic shutter and audible warning — — —
Regulation of the speed by mechanical regulator Regulation of the feed	Regulation of the speed, centrifugal type Regulation of the feed, for 2 pumps
Air : 1	Air : 4 - Lubricating oil : 2

TABLE 5. — **Types of engi**

Owner Administration :	*French Equatorial Africa and the Cameroons Railways* (ABJ 6)
Type	517 – J*
Maker	Renault
Nominal power in HP	300 (at 1 500 r.p.m.)
2 stroke / 4 stroke Horizontal / vertical / in V	4 stroke —
Average speed of the piston at nominal speed in m/sec	8
System of supercharging	—
Supercharge air pressure at full load in kg/cm²	—
Increase in the power compared with non-supercharged engine in %	—
System of cooling the engine	By water
System of dissipating the heat in the engine lubricating oil	—
Weight of diesel engine (without lubricating oil) in kg	2 400
Ratio $\frac{\text{weight}}{\text{HP}}$ in kg	8
Temperature of exhaust gases at full load and nominal speed : — at the collar of the exhaust collector	472° C
— at the entry to the turbo-compressor	—
Lubrication by lubricating oil with additions or without additions	With additions
Viscosity in SAE	40 (to 20° C)
Special safety devices : against corrosion against pitting against erosion against excess speed against insufficient oil pressure against excessive oil temperature against insufficient water left against excessive water temperature against insufficient oil pressure on starting against too low water temperature on starting against other factors not mentioned above	— — — — Pressure gauge and luminous shutter Thermometer Water level gauge with check lamp — — — —
Principle of regulation	Regulation of the speed Regulation of the feed
Filters on the engine for	Air : 4 - Lubricating oil : 1 - Fuel oil : 1

* An identical engine is used on the railcars of the French West African and Togoland Light Railways, and the railcars o
the Royal Cambodian Railways.

used in Diesel railcars *(continued)*.

Italian State Railways (772)	*Italian State Railways* (880)
BXD	D 19
O M	Breda
150 (at 1 500 r.p.m.)	450 (at 1 500 r.p.m.)
4 stroke —	4 stroke —
9	9.5
—	Exhaust gases turbo-compressor
—	—
—	—
By water	By water
By the engine cooling water (heat exchanger)	Cooling by air with special fan
—	—
—	—
558° C (place where temperature was measured not stated)	558° C (place where temperature was measured not stated)
—	—
With additions	With additions
30 (to 20° C)	30 (to 20° C)
NALCO 39 and DISCKRO TSIO products being tested — Light signals — — Light signals — — —	NALCO 39 and DISCKRO TSIO products being tested — Light signals — — Light signals — — —
Regulation of the feed	Regulation of the feed
Air, lubricating oil, and fuel oil	Air, lubricating oil, and fuel oil

TABLE 5. — Types of engi

Owner Administration :	*Italian State Railways* (668)
Type	203
Maker	Fiat
Nominal power in HP	165 (at 2 000 r.p.m.)
2 stroke / 4 stroke Horizontal / vertical / in V	4 stroke —
Average speed of the piston at nominal speed in m/sec	9.7
System of supercharging	Exhaust gases turbo-compressor
Supercharge air pressure at full load in kg/cm²	1.48
Increase in the power compared with non-supercharged engine in %	30
System of cooling the engine	By water
System of dissipating the heat in the engine lubricating oil	Cooling by air with special fan
Weight of diesel engine (without lubricating oil) in kg	—
Ratio $\frac{\text{weight}}{\text{HP}}$ in kg	—
Temperature of exhaust gases at full load and nominal speed : — at the collar of the exhaust collector	558° C (place where temperature was measured not stated)
— at the entry to the turbo-compressor	—
Lubrication by lubricating oil with additions or without additions	With additions
Viscosity in SAE	30 (to 20° C)
Special safety devices : against corrosion against pitting against erosion against excess speed against insufficient oil pressure against excessive oil temperature against insufficient water reserve against excessive water temperature against insufficient oil pressure on starting against too low water temperature on starting against other factors not mentioned above	NALCO and DISCKRO TSIO products being tested — Light signals — — Light signals — — —
Principle of regulation	Regulation of the feed
Filters on the engine for	Air, lubricating oil and fuel oil

sed in Diesel railcars *(continued)*.

Luxemburg Railways (1 A)	*Luxemburg Railways* (B B)
U 9	Diesel BXDS
Büssing	Saurer
110 (at 1 800 r.p.m.)	160 (at 1 500 r.p.m.)
4 stroke —	— —
8.4	9
—	—
—	—
—	—
By water	By water
—	—
800	1 200
7.2	7.5
505° C (place where temperature was measured not stated)	500/600°C (place where temper. was measured not stated)
—	—
With additions	With additions
Summer : 30 (to 50° C) — Winter : 20 (to 50° C)	Summer : 30 (to 50° C) — Winter : 20 (to 50° C)
Product with a chromate of sodium base — — — — — — — — —	Product with chromate of sodium base — — — Signal light — Signal light Thermostat — — —
Regulation of speed (min. and max.)	Regulation of speed (min. and max., only)
Air : 1 - Lubricating oil : 1 - Fuel oil : 1	Air : 2 - Lubricating oil : 2 - Fuel oil 2

TABLE 5. — **Types of eng**

Owner Administration :	*Luxemburg Railways* (BB/BB)
Type	A 12 L 614
Maker	Kloeckner – Humboldt – Deutz
Nominal power in HP	200 (at 2 000 r.p.m.)
2 stroke / 4 stroke Horizontal / vertical / in V	4 stroke —
Average speed of the piston at nominal speed in m/sec	9.3
System of supercharging	—
Supercharge air pressure at full load in kg/cm²	—
Increase in the power compared with non-supercharged engine in %	—
System of cooling the engine	By air
System of dissipating the heat in the engine lubricating oil	System of cooling by air with special fan
Weight of diesel engine (without lubricating oil) in kg	1 250
Ratio $\frac{\text{weight}}{\text{HP}}$ in kg	6.25
Temperature of exhaust gases at full load and nominal speed : — at the collar of the exhaust collector	550 / 600° C
— at the entry to the turbo-compressor	—
Lubrication by lubricating oil with additions or without additions	With additions
Viscosity in SAE	Summer : 30 (to 50° C) — Winter : 20 (to 50° C)
Special safety devices : against corrosion against pitting against erosion against excess speed against insufficient oil pressure against excessive oil temperature against insufficient water left against excessive water temperature against insufficient oil pressure on starting against too low water temperature on starting against other factors not mentioned above	— — — Electromagnetic relay Electromagnetic relay Electro-magnetic relay controlled by thermostat — — Shunt breaker — Protective device against engine catching fire
Principle of regulation	Regulation of the feed
Filters on the engine for	Air : 2 - Lubricating oil : 4 - Fuel oil : 2

ed in Diesel railcars *(continued)*.

Netherlands Railways (DE 1)	*Netherlands Railways* (DE 2)
A 220	A 220
AEC Ltd. Southal, Middlesex, England	AEC Ltd. Southal, Middlesex, England
140 (at 1 750 r.p.m.)	180 (at 1 750 r.p.m.)
— Horizontal	— Horizontal
8.3	8.3
—	Exhaust gases turbo-compressor
—	1.45
—	30
By water	By water
System of cooling by air, by fan	System of cooling by air, by fan
750	750
5.3	4.1
600° C (place where temperature was measured not stated)	600° C (place where temperature was measured not stated)
—	—
With additions	With additions
20 (to 20° C)	20 (to 20° C)
— — — Diesel engine stops Diesel engine stops — Diesel engine stops * Running light — — —	— — — Diesel engine stops Diesel engine stops — Diesel engine stops Running light — — —
Approximate regulation of the speed Regulation of the feed	Approximate regulation of the speed Regulation of the feed
Air : 1 - Lubricating oil : 1 - Fuel oil : 1	Air : 1 - Lubricating oil : 1 - Fuel oil : 1

* Against insufficient water pressure and not sufficient reserve of water.

TABLE 5. — **Types of eng**

Owner Administration :	*Polish State Railways*
Type	OM B x D
Maker	OM Brescia
Nominal power in HP	150 (at 1 500 r.p.m.)
2 stroke / 4 stroke Horizontal / vertical / in V	4 stroke —
Average speed of the piston at nominal speed in m/sec	—
System of supercharging	—
Supercharge air pressure at full load in kg/cm²	—
Increase in the power compared with non-supercharged engine in %	—
System of cooling the engine	By water
System of dissipating the heat in the engine lubricating oil	—
Weight of diesel engine (without lubricating oil) in kg	1 290
Ratio $\frac{\text{weight}}{\text{HP}}$ in kg	8.6
Temperature of exhaust gases at full load and nominal speed : — at the collar of the exhaust collector	—
— at the entry to the turbo-compressor	—
Lubrication by lubricating oil with additions or without additions	—
Viscosity in SAE	—
Special safety devices : against corrosion against pitting against erosion against excess speed against insufficient oil pressure against excessive oil temperature against insufficient water left against excessive water temperature against insufficient oil pressure on starting against too low water temperature on starting against other factors not mentioned above	— — — — — — — — — — — —
Principle of regulation	—
Filters on the engine for	—

ed in Diesel railcars *(continued)*.

Polish State Railways	*Portuguese Railways* (My 301/325)
VIII JAT 170/240	11.3
Ganz – Budapest	A E C
320 (at 1 250 r.p.m.)	200 (at 1 800 r.p.m.)
4 stroke —	4 stroke Horizontal
—	8.8
—	Exhaust gases turbo-compressor
—	0.5 to 1
—	33.33
By water	By water
—	The engine cooling water (heat exchanger)
3 750	800
11.1	4
—	400/500° C (place where temper. was measured not indicated)
—	—
—	With additions
—	40 (to 20° C)
— — — — Yes — — — — — —	Tartografite — — — Relays Relays — Relays Relays — Fire
—	Combined regulation of the speed and the feed
—	Air : 1 - Lubricating oil : 2 - Fuel oil : 2

TABLE 5. — **Types of engi**

Owner Administration :	*Portuguese Railways*
Type	D 812
Maker	Scania-Vabis
Nominal power in HP	160 (at 1 900 r.p.m.)
2 stroke / 4 stroke Horizontal / vertical / in V	4 stroke —
Average speed of the piston at nominal speed in m/sec	7.8
System of supercharging	—
Supercharge air pressure at full load in kg/cm²	—
Increase in the power compared with non-supercharged engine in %	—
System of cooling the engine	By water
System of dissipating the heat in the engine lubricating oil	Cooling system by air without special fan
Weight of diesel engine (without lubricating oil) in kg	630
Ratio $\frac{\text{weight}}{\text{HP}}$ in kg	3.9
Temperature of exhaust gases at full load and nominal speed : — at the collar of the exhaust collector	550/600° C (place where temper. was measured not stated
— at the entry to the turbo-compressor	—
Lubrication by lubricating oil with additions or without additions	With additions
Viscosity in SAE	30 (to 20° C)
Special safety devices : against corrosion against pitting against erosion against excess speed against insufficient oil pressure against excessive oil temperature against insufficient water left against excessive water temperature against insufficient oil pressure on starting against too low water temperature on starting against other factors not mentioned above	Tartografite — — — Red light — — Thermostat — — —
Principle of regulation	Combined regulation of the speed and the feed
Filters on the engine for	Air : 2 - Lubricating oil : 1 - Fuel oil : 1

ised in Diesel railcars *(continued)*.

Portuguese Railways (My 101/115)	*Jugoslavian Railways* (D mot 126)
D 802 Diesel	U 10 150 HP
Scania-Vabis	Büssing Braunschweig
137 (at 1 750 r.p.m.)	150 (at 1 900 r.p.m.)
4 stroke —	— —
7.8	9.5
—	—
—	—
—	—
By water	By water
Cooling system by air without special fan	The engine cooling water (heat exchanger)
630	710
4.5	12.6
550/600° C (place where temper. was measured not stated)	—
—	—
With additions	With additions
30 (to 20° C)	30 (at 20° C)
Tartografite — — Red light — — Thermostat — — —	— — — Regulator Optical signal Thermometer — — — — —
Combined regulation of the speed and the feed	Regulation of the feed
Air : 2 - Lubricating oil : 1 - Fuel oil : 1	Air : 1 - Lubricating oil : 1 - Fuel oil : 1

TABLE 5. — Types of engi

Owner Administration :	*Austrian Federal Railways* (VT 5145)
Type	S 12a
Maker	Simmering – Graz – Pauker A.G., Wien
Nominal power in HP	550 (at 1 400 r.p.m.)
2 stroke / 4 stroke Horizontal / vertical / in V	4 stroke —
Average speed of the piston at nominal speed in m/sec	13.9
System of supercharging	Exhaust gases turbo-compressor
Supercharge air pressure at full load in kg/cm²	1.3
Increase in the power compared with non-supercharged engine in %	32
System of cooling the engine	By water
System of dissipating the heat in the engine lubricating oil	By the engine cooling water (heat exchanger)
Weight of diesel engine (without lubricating oil) in kg	4 200
Ratio $\frac{\text{weight}}{\text{HP}}$ in kg	7.6
Temperature of exhaust gases at full load and nominal speed : — at the collar of the exhaust collector	480° C (place where temperature was measured not indicated
— at the entry to the turbo-compressor	—
Lubrication by lubricating oil with additions or without additions	Without additions
Viscosity in SAE	30 (at 50° C)
Special safety devices : against corrosion against pitting against erosion against excess speed against insufficient oil pressure against excessive oil temperature against insufficient water left against excessive water temperature against insufficient oil pressure on starting against too low water temperature on starting against other factors not mentioned above	 — — — Speed regulator and indicator * Light signal and audible warning * — Water level indicator and audible warning * Temperature indicator and audible warning * Light signal * — Electric lubricating pump — —
Principle of regulation	Combined regulation of the speed and the feed
Filters on the engine for	Air : 3 - Lubricating oil : 1 - Fuel oil : 2

* In driving compartment.

ised in Diesel railcars *(continued)*.

Colonial Transport Office (OTRACO)	*Italian State Railways* (990)
6 k 103 HS	S B D
S E M	O M
410 (at 1 350 r.p.m.)	480 (at 1 400 r.p.m.)
4 stroke	4 stroke
—	—
10.8	9.3
Exhaust gases turbo-compressor	—
1.39	—
28	—
By water	By water
By engine cooling water (heat exchanger)	By engine cooling water (heat exchanger)
3 500	—
8.5	—
—	558° C (place where temperature was measured not stated)
600° C	—
With additions	With additions
30 (at 20° C)	30 (at 20° C)
—	NALCO 39 and DISCKRO TSIO products being tested
—	
—	
Centrif. force regulat. a. elect. contacts acting on a servo-mot.	—
Manostat with electric contacts acting on a servo-motor	Light signals
—	—
—	—
Thermostat with electric contacts acting on a servo-motor	Light signals
—	—
—	—
—	—
Regulation of the feed — throttle control	Regulation of the feed
Air : 2 - Lubricating oil : 1 - Fuel oil : 1	Air, lubricating oil and fuel oil

TABLE 5. — Types of eng

Owner Administration :	*Italian State Railways* (773)
Type	B X D U L
Maker	O M
Nominal power in HP	200 (at 1 500 r.p.m.)
2 stroke / 4 stroke Horizontal / vertical / in V	4 stroke —
Average speed of the piston at nominal speed in m/sec	9
System of supercharging	Exhaust gases turbo-compressor
Supercharge air pressure at full load in kg/cm²	1.42
Increase in the power compared with non-supercharged engine in %	33
System of cooling the engine	By water
System of dissipating the heat in the engine lubricating oil	By engine cooling water (heat exchanger)
Weight of diesel engine (without lubricating oil) in kg	—
Ratio $\frac{\text{weight}}{\text{HP}}$ in kg	—
Temperature of exhaust gases at full load and nominal speed : — at the collar of the exhaust collector	558° C (place where temperature was measured not stated
— at the entry to the turbo-compressor	—
Lubrication by lubricating oil with additions or without additions	With additions
Viscosity in SAE	30 (to 20° C)
Special safety devices : against corrosion against pitting against erosion against excess speed against insufficient oil pressure against excessive oil temperature against insufficient water left against excessive water temperature against insufficient oil pressure on starting against too low water temperature on starting against other factors not mentioned above	NALCO 39 and DISCKRO TSIO products being tested — Light signals — — Light signals — — —
Principle of regulation	Regulation of the feed
Filters on the engine for	Air, lubricating oil and fuel oil

ısed in Diesel railcars *(continued)*.

Portuguese Railways (My 501/506)	*Italian State Railways* (T E E)
S B D	D 19 SBI 2 P
Fiat-OM	Breda
505 (at 1 400 r.p.m.)	490 (at 1 500 r.p.m.)
4 stroke —	4 stroke —
9.3	9.5
—	Exhaust gases turbo-compressor
—	—
—	—
By water	By water
By engine cooling water (heat exchanger)	Cooling by air with special fan
3 600	—
7.1	—
600° C	558° C (place where temperature was measured not stated)
—	—
With additions	With additions
30 (to 20° C)	30 (to 20° C)
Dearborne 517 — — Injection pump regulator — — — — — — —	NALCO 39 and DISCKRO TS 10 products being tested — Device to stop the engines — — Device to stop the engines — — —
Combined regulation of the speed and the feed	Regulation of the feed
Air : 2 - Lubricating oil : 4 - Fuel oil : 4	Air, lubricating oil and fuel oil

TABLE 5. — **Types of engines used in Diesel railcars** *(continued)*.

Owner Administration :	*Netherlands Railways* (T E E)
Type	R UH B 1616 *
Maker	Werkspoor
Nominal power in HP	1 000 (at 1 400 r.p.m.)
2 stroke / 4 stroke Horizontal / vertical / in V	4 stroke —
Average speed of the piston at nominal speed in m/sec	9.24
System of supercharging	Exhaust gases turbo-compressor (2 per engine)
Supercharge air pressure at full load in kg/cm²	1.60
Increase in the power compared with non-supercharged engine in %	± 30
System of cooling the engine	By water
System of dissipating the heat in the engine lubricating oil	By engine cooling water (heat exchanger)
Weight of diesel engine (without lubricating oil) in kg	5 900
Ratio $\frac{\text{weight}}{\text{HP}}$ in kg	—
Temperature of exhaust gases at full load and nominal speed : — at the collar of the exhaust collector	—
— at the entry to the turbo-compressor	530° C
Lubrication by lubricating oil with additions or without additions	With additions
Viscosity in SAE	30 (to 20° C)
Special safety devices : against corrosion against pitting against erosion against excess speed against insufficient oil pressure against excessive oil temperature against insufficient reserve and pressure of water against excessive water temperature against insufficient oil pressure on starting against too low water temperature on starting against other factors not mentioned above	 — — — Stopping the Diesel engine Stopping the Diesel engine — Stopping the Diesel engine Running light — — If the fire estinguishers have to be used, the Diesel engine automatically stops.
Principle of regulation	Regulation of the speed
Filters on the engine for	Air, lubricating oil and fuel oil

* An identical engine is used on the RAm train of the Swiss Federal Railways.

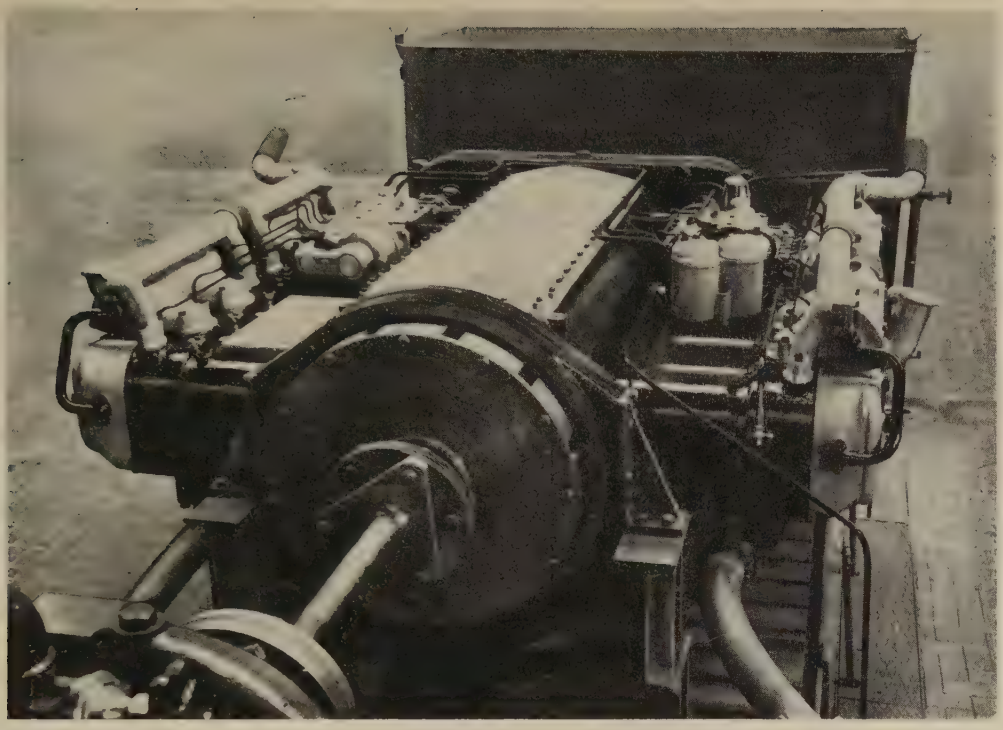


Fig. 37. — *F.S.* : OM - SBD engine - 480 HP (ALn 990 railcar). (See Table 5.)

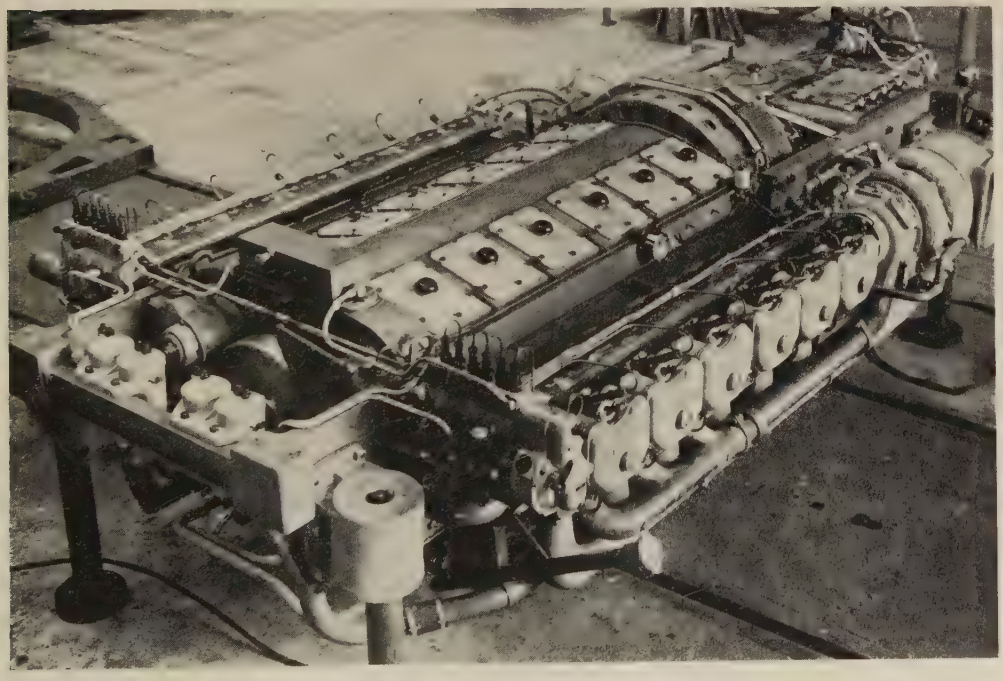
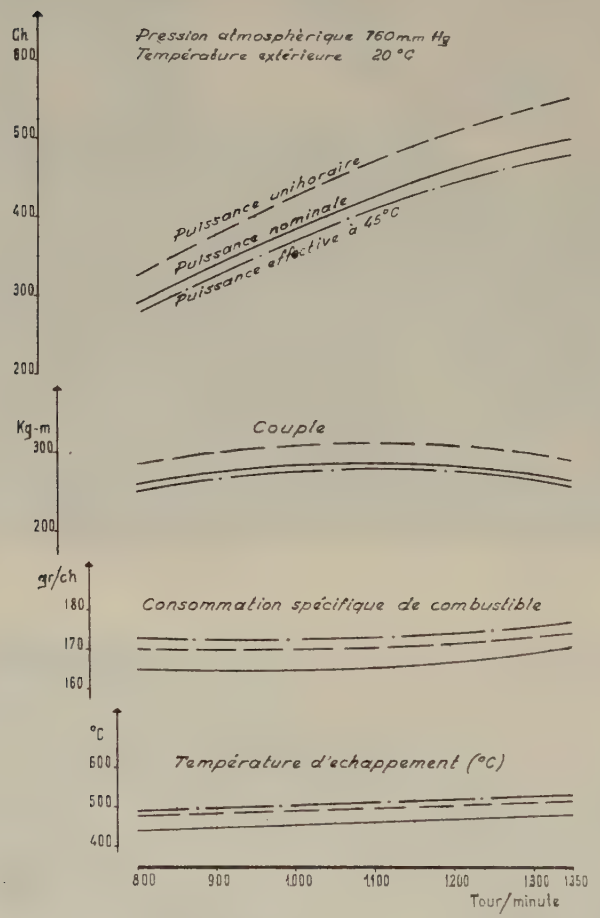


Fig. 38. — *F.S.* : Breda engine - D 19 - 450 HP (ALn 880 railcar). (See Table 5.)



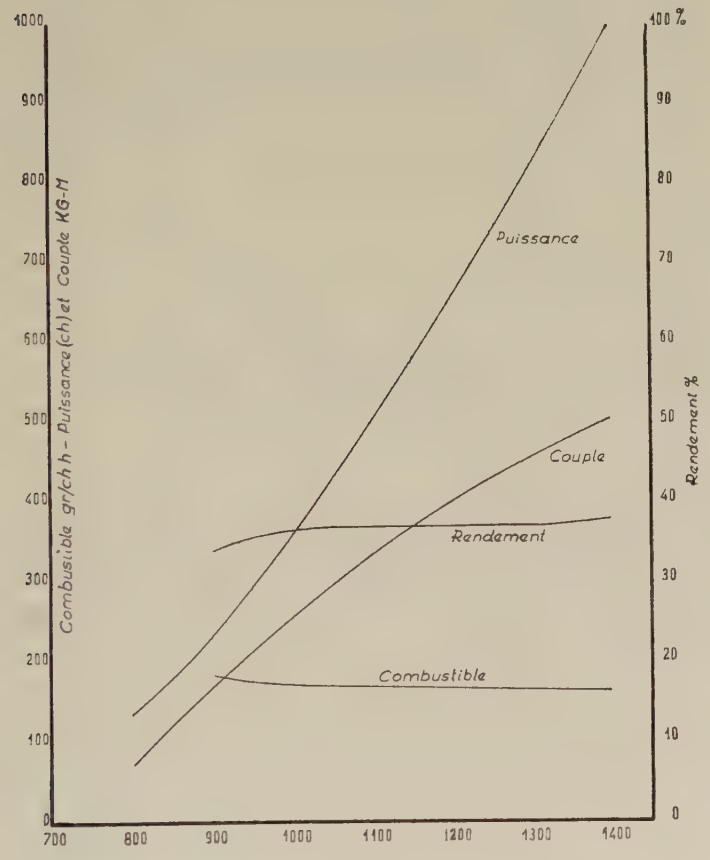
Characteristics curves.

(See Table 5.)

Fig. 39. — *Ö.B.B.* : S 12 a. engine.
VT 5 145 + VS 6 645 double railcar.

Explanation of French wording :

Pression atmosphérique = atmospheric pressure. — Température extérieure = outside temperature. — Puissance unihoraire = power at hourly rating. — Puissance nominale = nominal power. — Puissance effective = effective power. — Couple = torque. — Consommation spécifique de combustible = specific fuel consumption. — Température d'échappement = exhaust temperature. — Tour/minute = r.p.m.



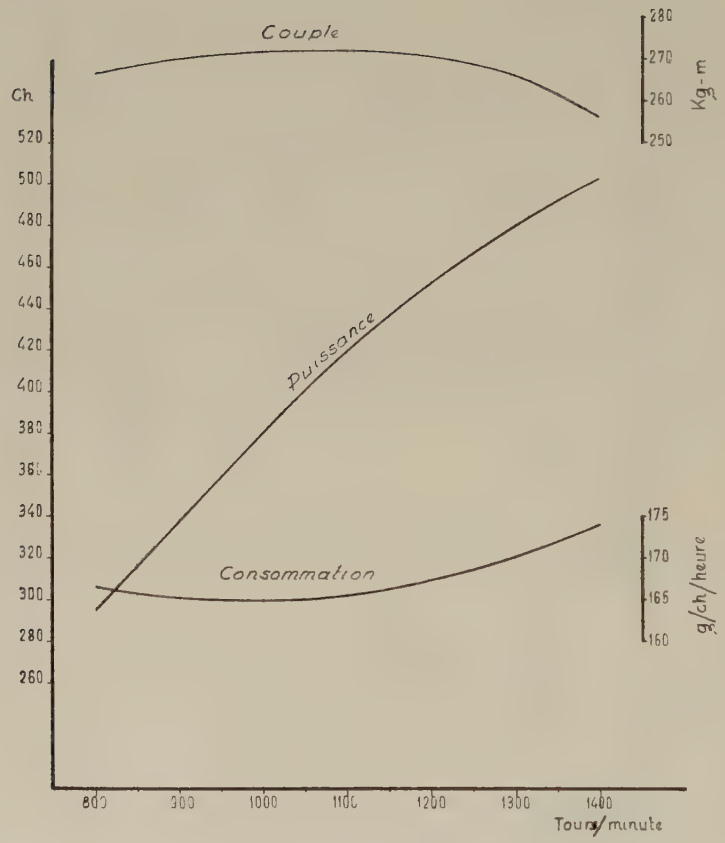
Characteristics curves.

(See Table 5.)

Fig. 40. — *N.S.* : TEE four unit rake. RUHB 1 616 engine.

Explanation of French wording :

Puissance = power. — Couple = torque. — Rendement = output. — Combustible = fuel. — Combustible gr/ch/h - puissance (ch) et couple KG-M = Fuel g/HP/h - power (HP) and torque KG-M.



Characteristic curves.

(See Table 5.)

Fig 41. — *C.F.P.* : My 501/506 triple railcar. SBD engine.

Explanation of French wording :

Couple = torque. — Puissance = power. — Consommation = consumption. — Tours/minute = r.p.m.

Transmissions.

— Transmission efficiency curves (fig. 42 to 45);

— Photographs (fig. 46 to 48);

— Graphs of systems of drive adopted (fig. 49).

Output η, utilisation factor a, and transmission factor g of the mechanical transmission.

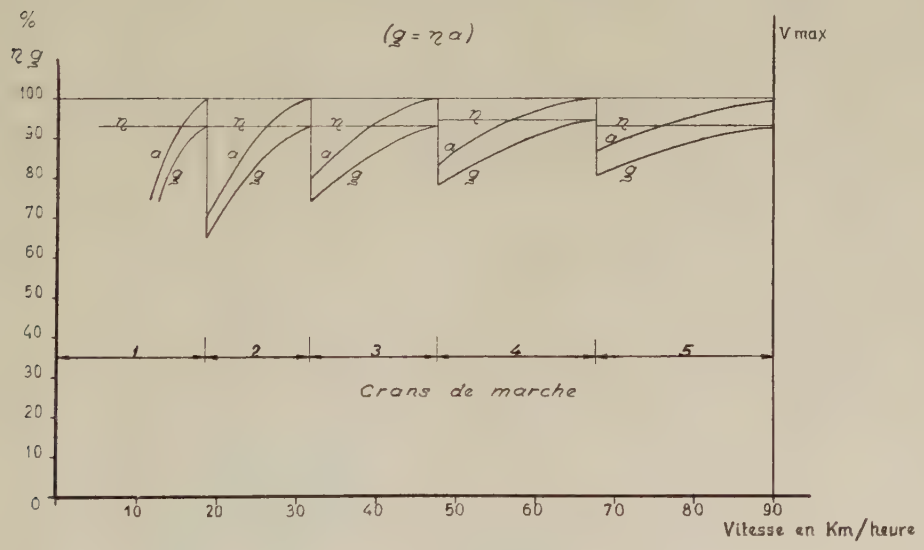
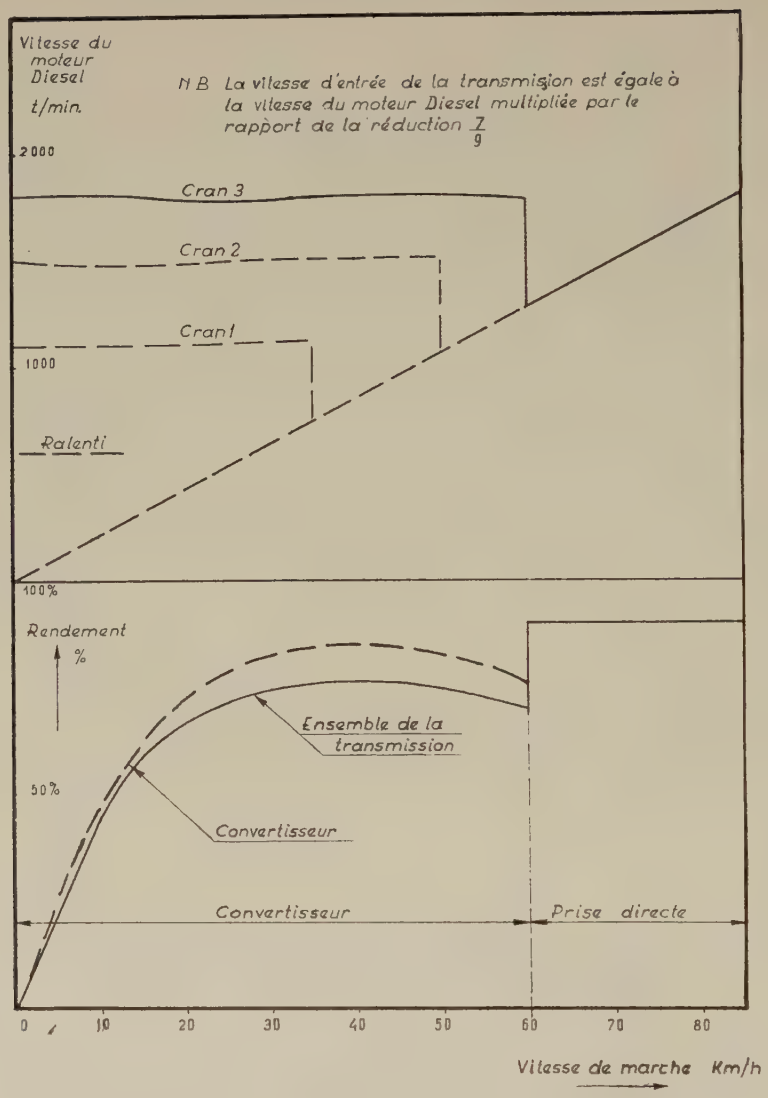


Fig. 42. — *Ö.B.B.* : Series 5 080 railcars (Stopping services).

Explanation of French wording :

Crans de marche = running notches. — Vitesse en km/h = Speed in km/h.



Speed of diesel engine and efficiency of the transmission as a function of the running speed.

Fig. 43. — *S.N.C.B.* : Type 604 railcar. Hydromechanical transmission.

Explanation of French wording :

Vitesse du moteur Diesel t/min. = speed of diesel engine r.p.m. — N.B. La vitesse d'entrée de la transmission est égale à la vitesse du moteur Diesel multipliée par le rapport de la réduction 7/9 = N.B. The speed at entry of the transmission is equal to the speed of the diesel engine multiplied by the reduction ratio 7/9. — Cran = notch. — Convertisseur = converter. — Ensemble de la transmission = transmission as a whole. — Rendement = output. — Ralenti = slowed down. — Prise directe = Direct pick up. — Vitesse de marche km/h — running speed km/h.

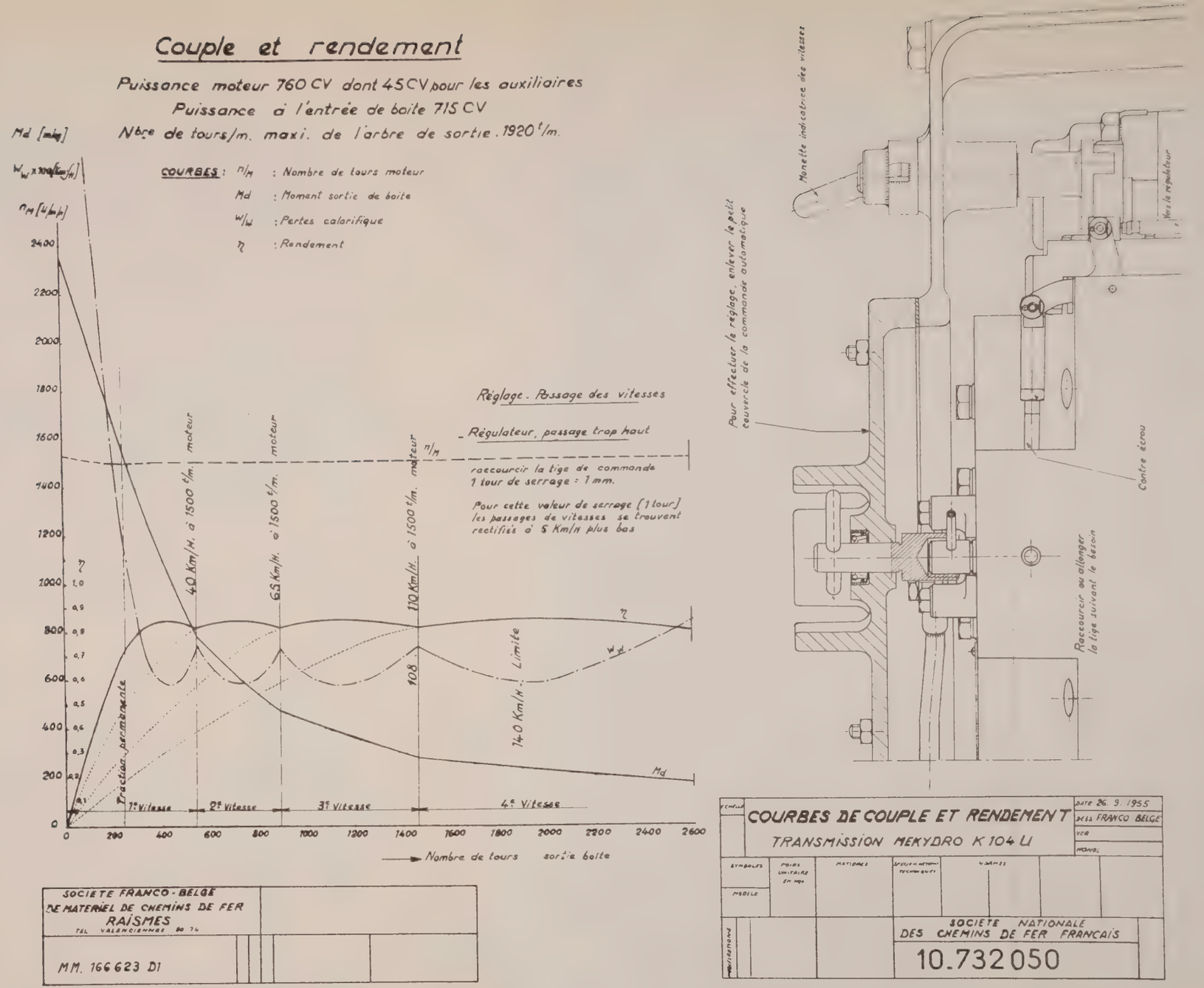

Couple et rendement
Puissance moteur 760 CV dont 45 CV pour les auxiliaires
Puissance à l'entrée de boite 715 CV
Nbre de tours/m. maxi. de l'arbre de sortie . 1920 t/m.
Md [mkg]
COURBES : n/M : Nombre de tours moteur
Md : Moment sortie de boite
W/H : Pertes calorifique
η : Rendement
Réglage . Passage des vitesses
Régulateur, passage trop haut
raccourcir la tige de commande
1 tour de serrage = 1 mm.
Pour cette valeur de serrage (1 tour)
les passages de vitesses se trouvent
rectifiés à 5 Km/h plus bas
40 Km/H. à 1500 t/m. moteur
65 Km/H. à 1500 t/m. moteur
110 Km/H. à 1500 t/m. moteur
108
Limite
74.0 Km/H.
Traction permanente
1re Vitesse
2e Vitesse
3e Vitesse
4e Vitesse
Nombre de tours sortie boite
Manette indicatrice des vitesses
Pour effectuer le réglage, enlever le petit couvercle de la commande automatique
Vers le régulateur
Contre écrou
Raccourcir ou allonger la tige suivant le besoin
SOCIETE FRANCO-BELGE
DE MATERIEL DE CHEMINS DE FER
RAISMES
TEL VALENCIENNES 80 74
MM. 166623 D1
COURBES DE COUPLE ET RENDEMENT
TRANSMISSION MEKYDRO K 104 U
Date 26. 9. 1955
ETS FRANCO BELGE
SOCIETE NATIONALE
DES CHEMINS DE FER FRANCAIS
10.732050

Fig. 44. — *S.N.C.F.* : RGP and TEE rakes. Torque and output curves. MEKYDRO K 104 U transmission.

Coupe et rendement = torque and output. — Puissance moteur 760 CV dont 45 CV pour les auxiliaires = power of engine 760 HP of which 45 HP for auxiliaries. — Puissance à l'entrée de boîte 715 CV = power at entry to box 715 HP. —Nbre de tours/m. maxi. de l'arbre de sortie : 1 920 t/m = r.p.m./mx. of shaft at exit : 1 920 r.p.m. — Coubes = curves. — Nombre de tours moteur = No. of revs engine. — Moment sortie de boîte = moment leaving the box. — Perte calorifique = calorific loss. — Rendement = output. — Réglage - passage des vitesses = regulation - change of speed. — Régulateur, passage trop haut = regulator, change too high. — Raccourcir la tige de commande, 1 tour de serrage : 1 mm. = shorten the control rod, tighten one turn : 1 mm. — Pour cette valeur de serrage (1 tour) les passages de vitesses se trouvent rectifiés à 5 km/h plus bas = for this amount of tightening (one turn) the speed changes are altered to 5 km lower. — Pour effectuer le réglage, enlever le petit couvercle de la commande électrique = to regulate remove the small cover of the automatic control. — Manette indicatrice des vitesses = handle of speed indicator. — Raccourcir ou allonger la tige suivant le besoin = shorten or lengthen the rod as required. — Contre écrou = check screw. — Vers le régulateur = Towards the regulator.

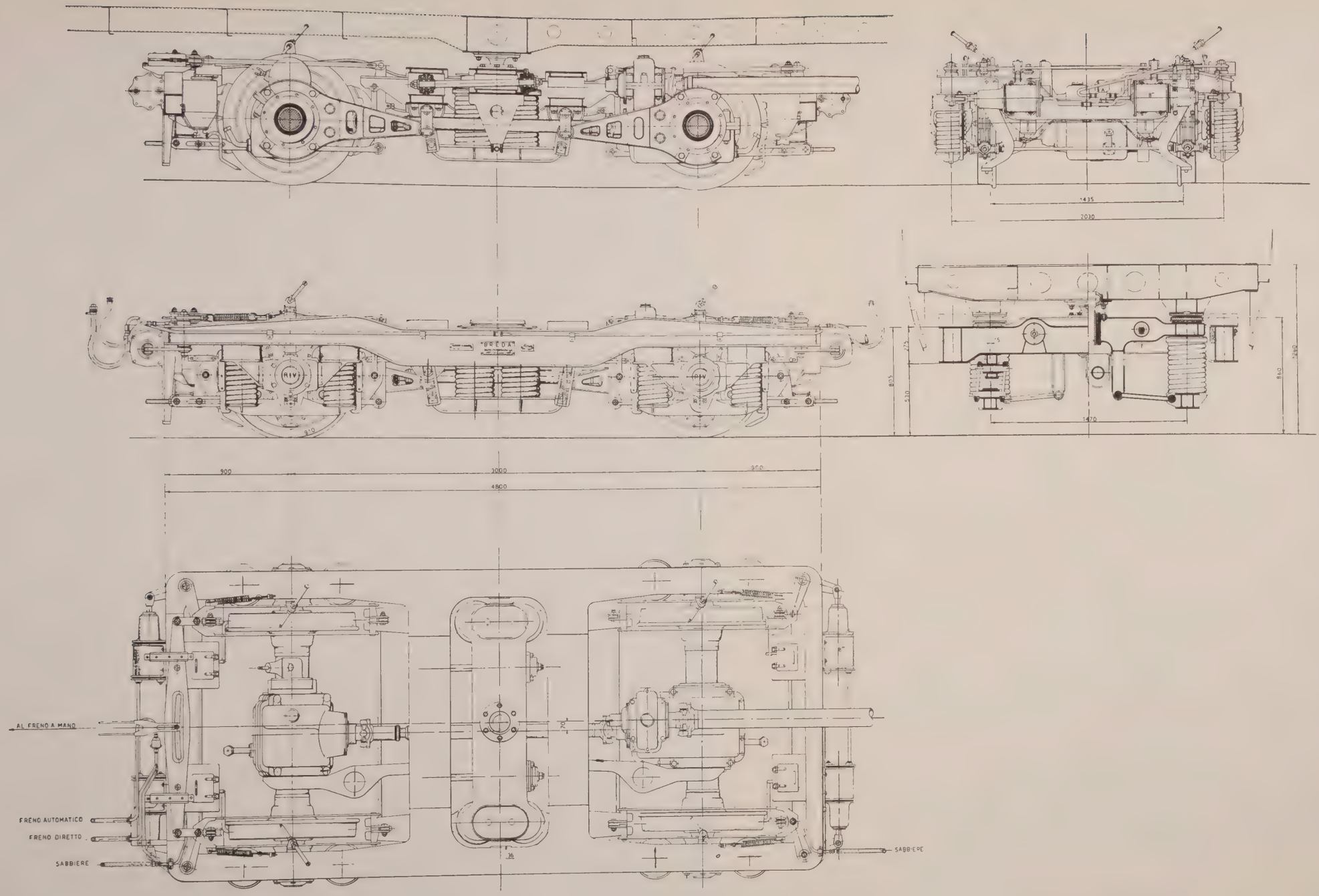


Fig. 47. — *F.S.* : TEE double rake - motor bogie.

Output η and transmission factor g for hydraulic transmission.

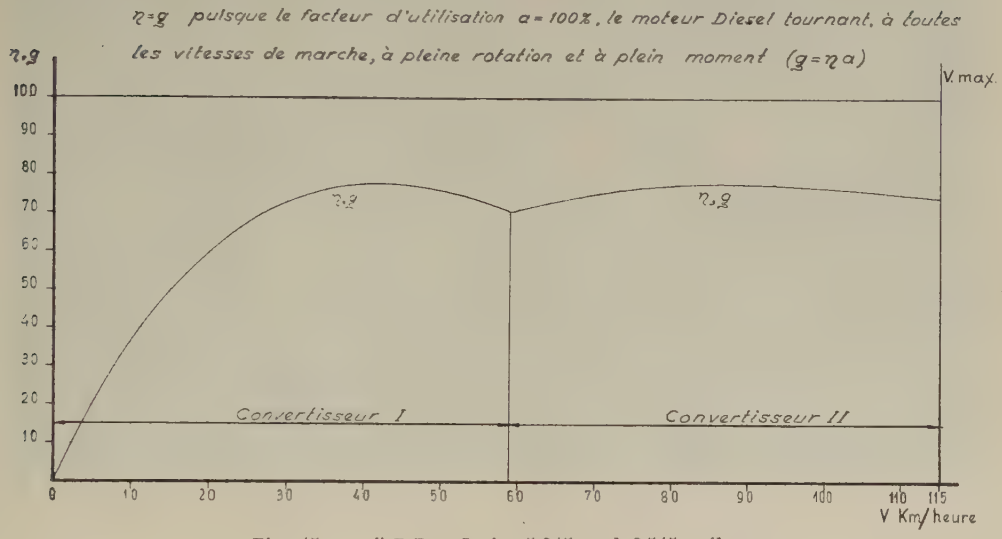


Fig. 45. — *Ö.B.B.* : Series 5 045 and 6 545 railcars.

Explanation of French wording :

η = g puisque le facteur d'utilisation a = 100 %, le moteur Diesel tournant, à toutes les vitesses de marche, à pleine rotation et à plein moment (g = na) = η = g since the utilisation factor a = 100 %, the diesel engine at all running speeds revolving fully and in full moment (g = na). — Convertisseur = converter. — V km/heure = speed km/hour.

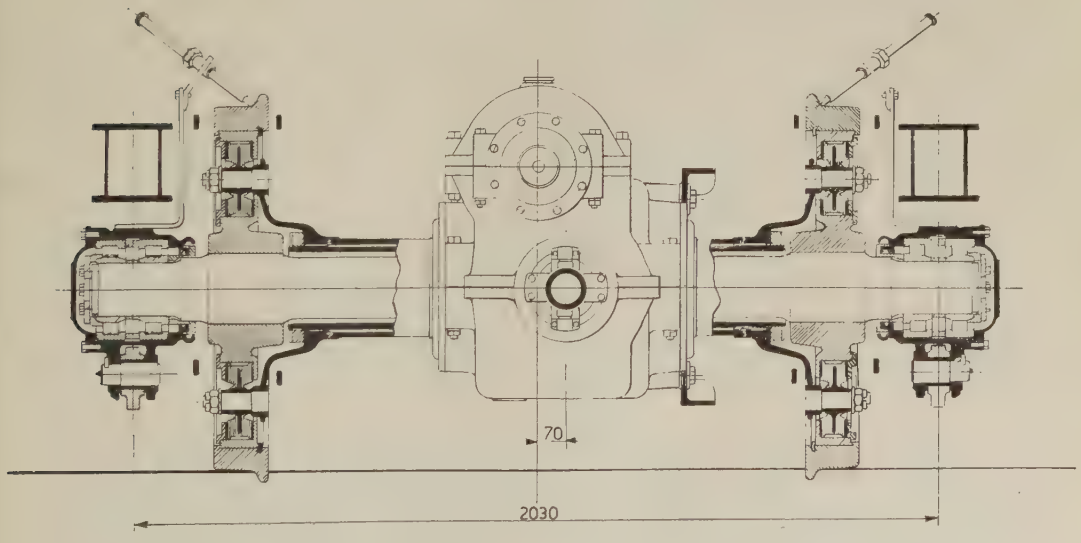


Fig. 46. — *F.S.* : TEE double rake - system of driving the motor axles.

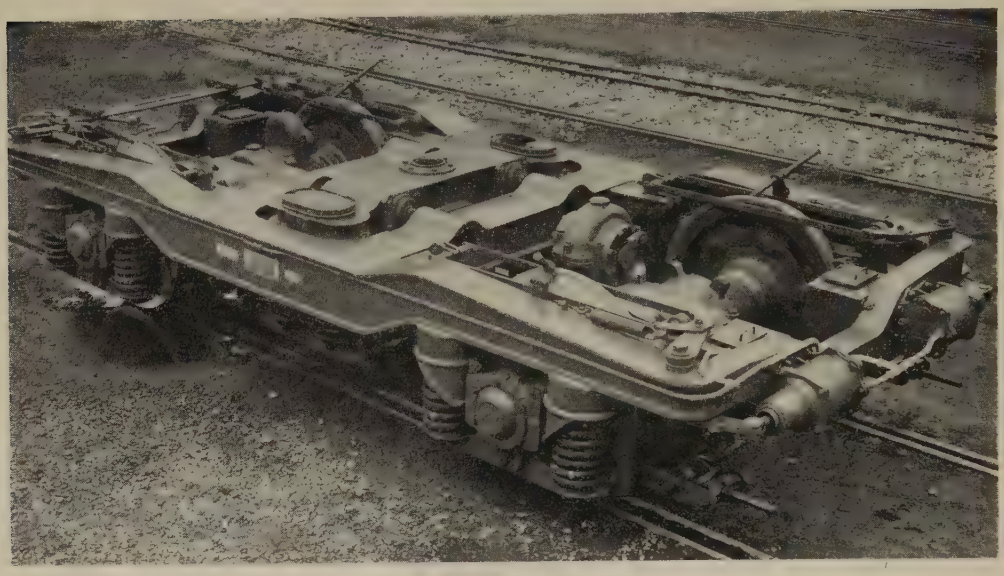


Fig. 48. — *F.S.* : TEE double rake - motor bogie.

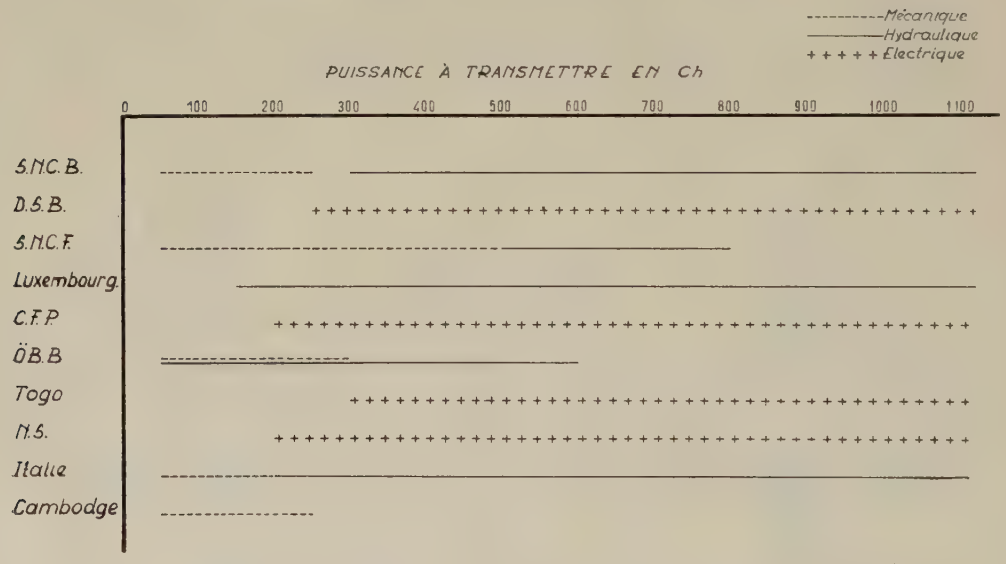


Fig. 49. — Transmission systems adopted according to the power to be transmitted.

Explanation of French wording :

Puissance à transmettre en ch = power to be transmitted in HP. — Mécanique = mechanical. — Hydraulique = hydraulic. — Electrique = electric. — Luxembourg = Luxemburg. — Italie = Italy. — Cambodge = Cambodia.

2. Body, bogies and their suspension.

Technique of construction.

Body. — For the framework of the body, the roof, walls and floor, welded construction, in ordinary steel, weight reduced or standard with the use of folded sheets or rolled sections (or made up by welding) is the solution generally adopted. There are also some mixed steel-light alloy constructions (for example the VT 5080 railcars of the Ö.B.B. for stopping services).

The outer covering likewise often consists of folded steel sheets and sometimes of aluminium alloys (welded or fastened to the framework).

For the inside covering, use is made, according to the case, of:

— aluminium or aluminium alloys;

— plywood (except in the engine compartments);

— plastic layers;

— aluminium alloy plate for the luggage compartments, and

— painted sheets for the driving and engine compartments.

Bogies. — Rolled sections or sections formed by welding and folded sheet are also used in the construction of the bogies; assembly is usually by welding (mixed construction using both welding and rivetting is also used).

The arrangements and constructional features adopted often differ from one Administration to another or according to whether the engine is on the bogie or not. We give them in the following Table 6.

The data included in this Table show that bogies are used with and without bolsters, and with and without bogie centre-pins.

As far as the sets of wheels are concerned, we find that full axles fitted with outside axle boxes, guided in slides, and wheels with tyres with cylindrical treads are used by most Administrations.

The S.N.C.F., however, on its recent railcars has used axles with inside boxes and monobloc wheels with conical bearings.

Inside boxes have the advantage of facilitating the inspection and maintenance of the rigging and brake shoes.

Suspension. — Table 7 sums up the various systems of suspension of the axles (primary) and body (secondary) used by the different Administrations. In the case of the secondary suspension, the connections between body and bogies also allow of lateral movement of the body in relation to the bogie ($\pm$ 30 mm for example) and include recall devices (recall brought about by the suspension of the body or lateral flexibility of the coiled springs, for example). Hydraulic shock absorbers are used in some cases and control the oscillations of the body, acting in either one direction only or in both directions.

In the primary suspension, the connections between axles and bogie frames on certains railcars do not allow of lateral relative displacement between these parts.

The transmission of the longitudinal stresses between the wheel sets and the body is realised, according to the case, either by the blades of the suspension springs (four wheeled trailer), or by the blades and carrying cables, or by the carrying blades and rods of the centre-pin (S.N.C.F.); or again, by guide rods, by rods fitted with silentblocs between the bogie and bolster and the body pivot (N.S); or finally, by the guard plates of the bogie and the body pivot (S.N.C.B.).

Ideas and opinions of the Administrations.

Welded steel construction is stipulated by most Railways for the body and the bogies.

The S.N.C.B. uses this type of construction, though certain non-stress carrying parts of the body are made of light alloy.

The S.N.C.F. prefers monobloc welded structures, in steel. This Company for-

TABLE 6.

BOGIES	Administrations which have adopted the system											
	Ö.B.B.	S.N.C.B.	D.S.B.	S.N.C.F.	Algeria	Cameroons	F.S.	Luxemburg	N.S.	C.F.P.	Jugoslavia	OTRACO
With bogie bolster	+				+		+	+	+	+		+
Without bogie bolster		+	+	+		+				+		
With bogie centre-pin	+	+	+		+	+		+	+	+		+
With false centre-pin				+								
Without centre-pin				+								
Sets of wheels :												
Axles — full	+	+	+	+	+	+	+	+	+	+	+	+
Axles — hollow	+	+										
Axle boxes — internal				+			+			+		
Axle boxes — external	+	+	+		+		+	+		+	+	+
Axle boxes — method of guiding												
Axle boxes — by slides	+	+	+		+		+		+	+		
Axle boxes — by cylindrical guides							+		+			+
Axle boxes — by guiding blades				+								
Axle boxes — by rods									+			
Wheels — with tyres	+	+	+			+	+	+	+	+		+
Wheels — monobloc				+	+					+		
Wheels — conicity of running surface — 1/10		+	+							+	+	+
Wheels — conicity of running surface — 1/15										+		
Wheels — conicity of running surface — 1/20		+	+			+		+	+	+	+	+
Wheels — conicity of running surface — 1/40				+	+		+					
Wheels — conicity of running surface — 1/60										+		
Wheels — conicity of running surface — 1/80									+			
Wheels — conicity of running surface — cylindrical	+											
Wheels — wheel seat — cylindrical	+	+	+		+	+	+	+	+	+	+	+
Wheels — wheel seat — conical				+					+			

TABLE 7.

Systems of suspension used	*Use by the Administrations*										
	Ö.B.B.	*S.N.C.B.*	*D.S.B.*	*S.N.C.F.*	*Algeria*	*F.S.*	*Luxemburg*	*N.S.*	*C.F.P.*	*Jugoslavia*	*OTRACO*
PRIMARY SUSPENSION											
Leaf springs :											
— with shock absorbers										+	
— without shock absorbers	+	+			+						
Coiled springs :											
— with shock absorbers							+	+			+
— without shock absorbers	+	+		+		+			+		
Coiled springs together with leaf springs :											
— without shock absorbers			+								
Coiled springs together with rubber springs :											
— without shock absorbers						+					
Leaf springs + coiled springs + rubber springs :											
— without shock absorbers	+										
Leaf springs + rubber springs											
— without shock absorbers	+										
SECONDARY SUSPENSION											
Leaf springs :											
— without shock absorbers	+	+	+		+	+		+	+		
Coiled springs :											
— with shock absorbers				+			+				+
Torsion bars :											
— without shock absorbers								+			
Rubber springs :											
— without shock absorbers		+			+						
Leaf springs + rubber springs :											
— without shock absorbers		+									
Mixed rubber and steel springs :											
— without shock absorbers						+					

merly used railcars whose body was entirely of light alloy which proved satisfactory, but they consider that such a practice is only of value in the case of small capacity railcars with a fairly short body.

In their opinion, the light metal loses much of its value in the case of bogie railcars with long bodies the framework of which is conditioned not by the stresses but the deflections.

The N.S. stipulate welded construction and the use of a non-alloy steel for the body with a resistance to traction of about 37 kg/mm², and consider that the tendency in the future will be to use sections made up of bent plates rather than rolled and prefabricated sections.

The C.F.P. prefer rustless steel for the body and ordinary steel for the bogies.

The Ö.B.B. also stipulate entirely welded construction as well as the use of St 34, St 37 M and St 42 M steels for all parts and rustless steel for the bodies of the fast long distance railcars.

The Netherlands Railways stipulate for the bogies not only welded construction, but also cast steel construction.

In order to improve the running qualities of the railcars, various designs of suspension have been adopted by the Railways.

The tendency seems to be towards the application of the following rules :

— use of coiled springs in both the primary and secondary suspension;

— use of shock absorbers, at least in the secondary suspension, or of auto-damping out springs, either of rubber or a mixture of rubber and steel;

— use of roller bearing axle boxes without slides excluding all longitudinal and transversal play in the primary suspension;

— control of the lateral displacement of the body, either by the rods of the secondary suspension, or by means of springs with hydraulic shock absorbers if needs be;

— no rubbing surfaces in the suspension and pivots;

— use of a suspension having great flexibility (oscillation cycle of about 1 Hz), the secondary suspension being somewhat more flexible than the primary suspension;

— bogie pivots in line with the axles, in order to avoid the transmission of vibrations due to the movement of the bogie to the body;

— recall of the rotation of the bogie by the inclination of the rods of the secondary suspension.

* * *

3. Weight reduction.

The objectives the Railways have in views as regards weight reduction in the construction of railcars and their trailers are essentially :

— for a given installed power and capacity of the railcars, to improve the performances, and likewise;

— with the same performances and capacities of railcars, to reduce the power installed.

A reduction in the purchase price and maintenance costs are also expected.

More especially, longer life of the tyres and less wear of the brake blocks is expected. Very extensive weight reduction cannot be considered in those special cases where railcars are also used as traction units, when they must have sufficient adhesive weight (hauled a relatively high number or ordinary coaches).

The value of the ratio « power installed/weight displaced » naturally varies according to the profile of the lines, the type of service or the category of railcar. The figures given by the Railways vary between 5 and 10 HP/t. We have classified them in the following table :

Ordinary services :

— on lines with easy profile (10 mm/m at most)	4.5 to 5 HP/t
— on lines of average profile (under 20 mm/m) :	
with simple railcar (light type or one that can be coupled up with a trailer)	5 to 6 HP/t
with a double or triple railcar	6.5 to 7.5 HP/t
with simple railcar that can be coupled up without the trailer	7.5 to 8 HP/t
— on lines of difficult profile (20 to 30 mm/m)	about 8 HP/t
Express services	8 to 10 HP/t

It will be noted that in the case of stopping services on easy profiles, the power of 4.5 HP/t means that the engine is frequently working at its maximum torque.

For such services a power of 7 to 8 HP/t is laid down by certain Railways owing to the frequent stops and the need for rapid starting up.

The Administrations consider that all attempts at weight reduction should cover all parts of the railcar which do not affect the safety, and that it is very important, in particular, not to overlook weight reduction in the case of the bogies and non-suspended parts.

The N.S. consider that it is possible to save 10 % on the weight of the bogies and the transmission compared with current more complicated designs.

As we have already said, welded construction in ordinary steel is as a general rule stipulated for the body and bogies of railcars by most Railways.

The use of rutsless steel in the construction of the body is under consideration by some Administrations in certain cases such as railcars for important services. The Netherlands Railways think, however, that the results that can be obtained with ordinary steel do not justify the additional expenditure on rustless steel or aluminium alloys.

The Danish Railways in their turn mention having used aluminium in certain cases, but without success. Under the atmospheric conditions of their country, serious deterioration was found.

In order to obtain a general reduction in weight of the vehicles, the Railways stipulate :

a) In the framework of the body :
- — the use of folded sheet profiles adapted to the requirements of a light and rigid type of construction, the use of pressings (in the case of large series) and a roof made of light alloy;
- — the generalisation of welded assemblies.

b) As regards the interior arrangement, as extensive a use as possible of aluminium alloys and plastic materials is stipulated.

Such a reduction in weight, which can be very extensive in the case of suburban services, must however be judiciously limited in the case of railcar for long runs owing to need to provide a sufficiently high standard of comfort.

As regards the effects of weight reduction on the running qualities of the railcars, very little information was given, as most of the Railways have insufficient experience of the light railcars.

The S.N.C.F. considers that the running qualities of modern railcars of light weight construction are not inferior, other conditions being equal (in particular the speed), to those of the ordinary stock.

The S.N.C.B. expresses a similar point of view provided that the constructional characteristics of the bogies are suitable for light weight construction.

In the opinion of this Railway it is necessary to point out above all the difficulty there is in eliminating the vibrations of light weight bodies.

The French Equatorial Africa and Cameroons Railways consider first of all that a reduction of 1 % in the overall weight of a railcar would justify an increase of 76 275 frs. C.F.A. in the cost of the vehicle. In the case of general purpose railcars, weighing about 50 t, the C.F.P. consider that a weight reduction of 1 % would justify an increased price of about 15 000 escudos, as long as the life, convenience and other technical conditions were not adversely affected by the weight reduction realised.

Regarding the condition of weight reduction of the railcars, whose general characteristics were given in the Introduction, the respective Administrations supplied the following data :

— the S.N.C.B. does not consider weight reduction has been carried far enough in the case of the railcars described, except in the case of the type 554 railcar.

In the case of new designs, this Company intends to go further as far as weight reduction is concerned;

— the S.N.C.F. considers all the railcars described as being of lightened construction compared with the ordinary stock and states that the greatest reduction in weight has been in the case of the 150 HP railcars. In their opinion — unless new stock is brought in — it is difficult to reduce the present weight per seat any more without adverse effects upon maintenance costs, owing to the ever increasing requirements involved by the comfort of the interior arrangements;

— the C.F.P. consider their « Nohab » (general purpose) railcars to be of light weight construction; these railcars can run at a maximum speed of 100 km/h with a trailer, carrying 178 passengers, with an installed power of 4.26 HP/t of the total weight of the rake;

— the Ö.B.B. consider their series 5080 stopping railcars as being of light weight construction, together with their series 7080 trailers;

— there are no railcars considered to be of a light weight type on the Danish nor Netherlands Railways;

— the F.S. only consider their 668 railcars with their trailers to be of a somewhat light weight construction.

Approximately we obtained the following average figures for the railcars described in the Introduction, which relate to extreme conditions (railcars grouped in the 1st and 3rd groups) :

	Railcars for ordinary services. (1st group)	*TEE rakes.* double.	for unit (*)
Railcars and trailers, power installed/seat	~ 3 HP	~ 10.5 HP	~ 17.5 HP
Weight/seat	400 kg	1 000 kg	1 900 kg

* With air conditioning installation.

* * *

4. Soundproofing.

Technique adopted.

The comfort of passengers to which the Administrations are paying more and more attention makes it necessary to reduce the running noises inside railway vehicles to a considerable extent. Such noises, which naturally increase with the speed of the vehicle, vary according to a great number of factors, such as the condition and design of the vehicle itself, the condition of the

permanent way, in particular the type of sleeper used (wood, reinforced concrete or metal), and the presence or not of undulatory wear of the rails.

This has been clearly shown by studies and very thorough research work, the results of which are widely known, carried out especially during recent years on this complex question of the acoustics of vehicles.

We may mention, for example, the research work done by the Deutsche Bundesbahn by means of their test vehicles equipped with electronic apparatus, which have made it possible to carry out a great many investigations and discover some important facts.

We will merely recall that in particular the technique adopted makes it possible :

— to know by the patch travelled by equiphone lines, the distribution of the various noise levels around the vehicle, and consequently to determine where sound proofing measures are particularly necessary;

— to determine the effectiveness of such measures, by comparing sound levels at two neighbouring points, on the inside and outside of the vehicle respectively;

— to record the noises (either the outside or the inside noises) and then analyse them, in order to determine the sources of the loudest noises (examination of the spectre of outside noises) or the absorbant qualities of the devices used (comparison of the spectre of outside noises with that of inside noises).

In the case of railcars, with which we are here concerned, to the running noises are added the noise of the motor installations and auxiliary services, which can often exceed them.

Additional measures therefore have to be taken to reduce these latter noises, not only inside the railcar but also outside it, so that it is not a source of annoyance whilst standing in the station or being shunted.

The fight against noise includes, in general, not only the suppression as far as possible of the actual sources of noise, but special measures in the construction of the railcars and the use of appropriate materials (glass wool, cork, slagwool, asbestos, pieces of felt, antivibrine, etc...) which isolate, damp out and absorb noises.

In other words, by the use of such materials an attempt is made to prevent noises passing through the body, to damp out the vibrations of all the vibrating parts — covering plates for example — and dissipate still further over the suitably prepared interior walls of the body as much as possible of the sonorous energy of any noises that have penetrated inside the body.

We give below the measures adopted to soundproof certain railcars, either against running noises, or against the noise of the motor installations.

S.N.C.F.

— Railcars X 5500, X 3800 and X 2400 soundproofed against running noises :

X 5500 — use of glass fibre in the interior cavities of the corrugated sheets used for the floor;

X 3800 — use of fireproofed cork, stuck into the corrugations of the floor sheeting;

X 2400 — application of ebonite foam to the corrugated sheets used for the floor + a false floor of plywood.

— Railcars X 2800, RGP and TEE soundproofed against running noises and the noise of the engines :

safety partition — lined with glass wool;

floor — use of asbestos sprayed on the corrugated sheet + glass wool between two sheets of plywood;

all outside walls — use of absorbant perforated glass wool panels in the ceiling.

S.N.C.B.

— Railcars 554 soundproofed against running noises :

A) Walls and ceiling :

— absorbant covering of glass felt 2 mm thick (150 g/m²);

— glass wool quilted mattress, 20 mm thick (160 g/m²) with polyethylene grains on ceiling, walls and heating ducts.

B) Floor :

a) compartment, brake compartment, driving compartment :

— a first series (the ten first numbers) have a floor of Hiduminium 44 W 2.5 mm thick and reheated Sidal 5 (Al Mg 5);

— a second series (the next ten numbers) have the corrugations filled in with granulated cork covered with 8 mm of expanded cork and 2 mm of linoleum stuck to the cork;

b) W. C. :

— « Permali » bakelised wood 14 mm thick and rubber carpet + 10 mm of glass wool + 0.5 mm reheated Al Mg 5 sheet;

c) cupboard :

— bakelised wood, 14 mm; glass wool, 10 mm; reheated Al Mg 5 sheet 5 mm thick.

The noise level inside the body when the outside level is 110 phons under the body of the railcar is 79 phons.

— Railcars 603, soundproofed against running noises and the noise of the actual engine :

— against running noises :

a) compartment :

above :

— 15 mm multiplex; 25 mm glass wool; 10 mm granulated cork moulded with flintcote;

below :

— 1 mm galvanised sheet.

b) above the engine :

— 15 mm multiplex; 25 mm glass wool; 12 mm linex; 25 mm glass wool; 8 mm linex; 10 mm pressed cork; sheet;

— against the noise of the engine itself :

— a space lined with glass wool between the wall of the chimney in which the exhaust pipe goes (flexible pipe to follow the movement of the bogie) and the protective duct the whole way up the railcar, 50 mm thick.

Noise level inside the body with an outside noise level of 110 phons under the railcar body : 63 phons.

N.S.

— DE 1 and DE 2 railcars.

Soundproofing against running noises :

— walls — isoflex (35 mm);

— floor — cork (28 mm);

Soundproofing against the noise of the engines :

— engines carried on « silentblocs » (double).

Level of noise inside the body : fairly satisfactory.

F.S.

— General arrangements :

— soundproofing the body — use of isolating materials in the walls, ceiling and floor, such as ultralite and asbestos (very careful isolation of the floor particularly those parts over the diesel engine);

— careful construction of the windows.

Ideas and opinions of the Administrations.

The Administrations are nearly unanimous in considering that in future all railcars and trailers should be soundproofed, no matter what their category. They suggest the adoption of a standard of soundproofing for such vehicles as close as possible to that adopted for the ordinary coaches.

With an outside noise level of 110 phons, at rail level, the noise should be limited to 65-70 phons inside the vehicle, stipulate certain Railways.

The N.S. do not calculate the inside noise level in phons and prefer to estimate it by the coefficient of intelligibility. This, they state, should be about 80.

As regards the most effective and advisable methods of soundproofing, only a relatively small number of Railways were able to supply us with information based on their actual experience.

Figure 50 shows the isolation method used on the S.N.C.B. on recent vehicles, with the following approximate results :

— 60 phons for 1st class coaches with separate compartments;

— 65 phons for 2nd class coaches with large compartments (with an outside noise level of 110 phons).

An essential factor is the soundproofing of the floor which has been obtained on recent S.N.C.F. stock by increasing the thickness of the floor (72 mm) and making it of various absorbant materials which include in particular some sufficiently thick material. Figure 51 shows the composition of the floor on the fast railcars of the S.N.C.F.

The walls and ceiling of the passenger compartments are isolated by the application of some product on the inside of the sheets and by packing with glass wool. Other products can also be used, such as isoflex, etc.

The N.S. prefer to use an asbestos flock for soundproofing.

As regards the methods used to reduce the noise made by the engine, especially the exhaust, the Railways stipulate in general the use of silencers on the non-supercharged engines in which the gases expand progressively. There are however some cases in which it is not considered necessary to use silencers.

In fact when the engines are supercharged by a turbo-blower driven by the exhaust gases, the turbo-blower itself damps out the noise by allowing the gases to expand progressively. The S.N.C.B. state that in this case they do not usually use an additional silencer.

The S.N.C.F. state that at the present time their railcars are not fitted with silencers on the exhaust, as experience has shown that during running the noise of the exhaust is hardly noticed by the passengers. On the other hand, as far as the people living alongside the railway are concerned, the use of a silencer on the exhaust gives good results; however silencers are only fitted on locomotives, either because the noise of the exhaust is so loud owing to their powerful engines, or because they are used for shunting in the stations and so are a greater nuisance to those living nearby than railcars running on the open track. In addition to the use of silencers, elastic mounting of the engines (on rubber) is also stipulated.

5. Heating, ventilation and air conditioning.

Heating and ventilation. — We have shown in Table 8 the various heating systems used at the present time on the railcars according to the information received from the Administrations.

As will be seen, sometimes several different systems are used on the railcars of a Railway.

In substance, they can all be grouped under the following types :

— heating by pulsated air;

— heating by hot air;

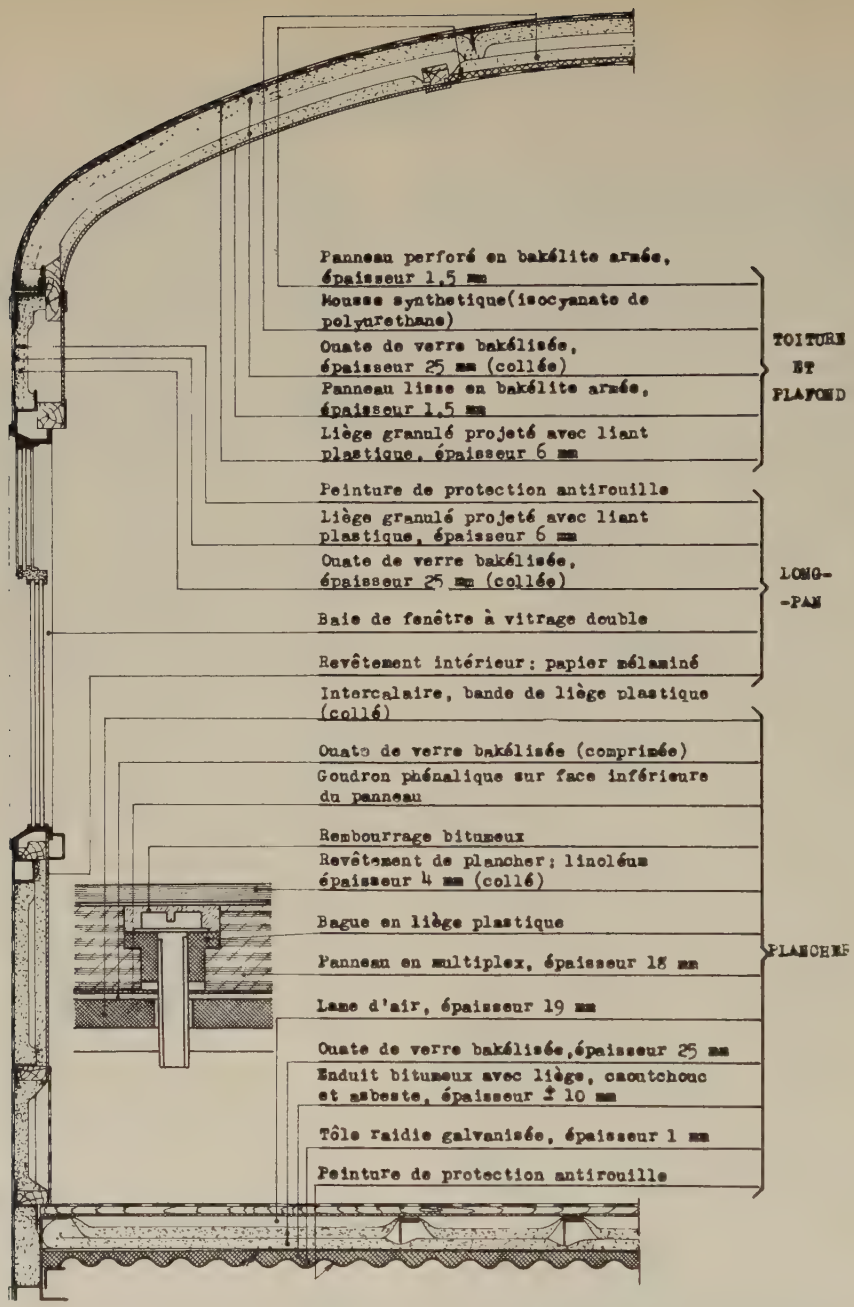

Panneau perforé en bakélite armée, épaisseur 1,5 mm
Mousse synthétique (isocyanate de polyuréthane)
Ouate de verre bakélisée, épaisseur 25 mm (collée)
Panneau lisse en bakélite armée, épaisseur 1,5 mm
Liège granulé projeté avec liant plastique, épaisseur 6 mm
TOITURE ET PLAFOND
Peinture de protection antirouille
Liège granulé projeté avec liant plastique, épaisseur 6 mm
Ouate de verre bakélisée, épaisseur 25 mm (collée)
LONG-PAN
Baie de fenêtre à vitrage double
Revêtement intérieur : papier mélaminé
Intercalaire, bande de liège plastique (collé)
Ouate de verre bakélisée (comprimée)
Goudron phénalique sur face inférieure du panneau
Rembourrage bitumeux
Revêtement de plancher : linoléum épaisseur 4 mm (collé)
Bague en liège plastique
Panneau en multiplex, épaisseur 18 mm
PLANCHER
Lame d'air, épaisseur 19 mm
Ouate de verre bakélisée, épaisseur 25 mm
Enduit bitumeux avec liège, caoutchouc et asbeste, épaisseur ± 10 mm
Tôle raidie galvanisée, épaisseur 1 mm
Peinture de protection antirouille

Fig. 50. — *S.N.C.B.* : Heat and sound insulation. Diagram of the principle.

Explanation of French wording (from top to bottom).

Roof & Ceiling :

Reinforced perforated bakelite panel, 1.5 mm thick. — Synthetic foam (isocyanate of polyurethane). — Bakelised glass wool, 25 mm thick (stuck on). — Smooth reinforced bakelite panel, 1.5 mm thick. — Granulated cork sprayed on with a plastic binder, 6 mm thick.

Walls :

Antirust protective paint. — Granulated cork sprayed on with plastic binder, 6 mm thick. — Bakelised glass wool, 25 mm thick (stuck on). — Double glazing of windows. — Interior covering : melamined (mélaminé) paper. — Strip of plastic cork (stuck on).

Floor :

Bakelised glass wool (compressed). — Phenalic tar on the inside of the panel. — Bituminous covering. — Floor covered with linoleum, 4 mm thick, (stuck down). — Ring of plastic cork. — Multiplex panel, 18 mm thick. — Air space, 19 mm wide. — Bakelised glass wool, 25 mm thick. — Bituminous layer with cork, rubber and asbestos ± 10 mm. — Stiffened galvanised sheet, 1 mm thick. — Antirust protective paint.

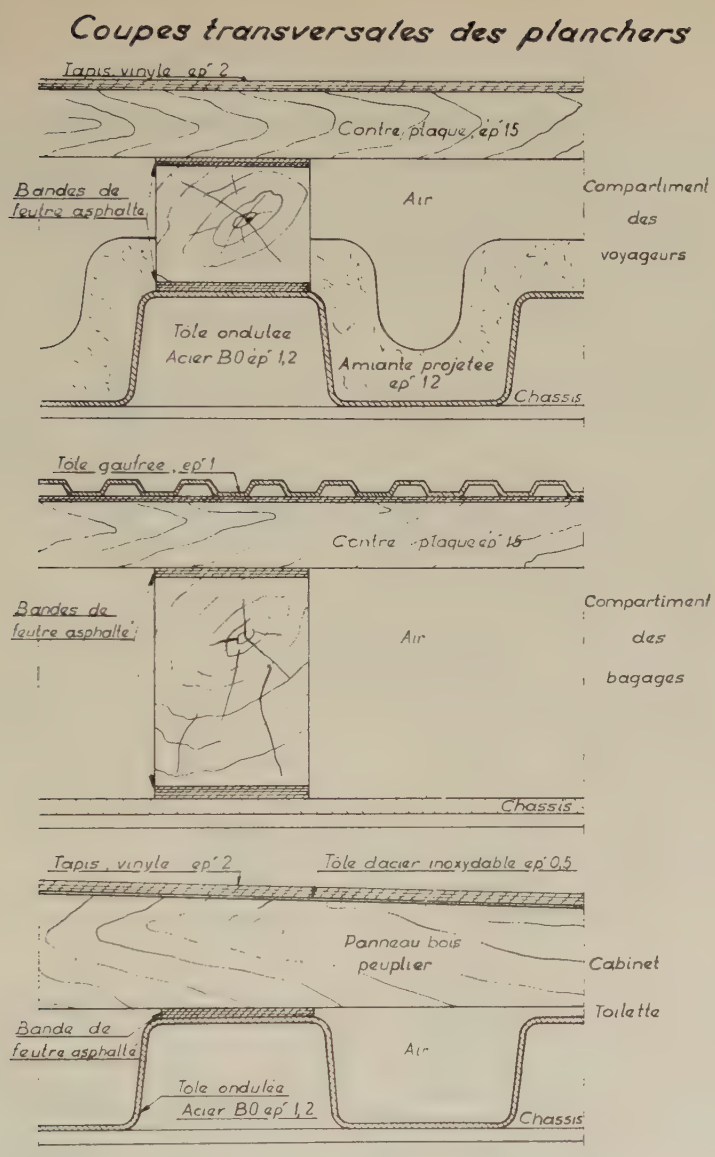


Fig. 51. — *S.N.C.F.* : Soundproofing the floor of the fast railcars (R.G.P.).

Explanation of French wording (from top to bottom).

Cross sections of floors.

Passenger compartment :

Vynil carpet, 2 mm thick. — Plywood, 15 mm thick. — Bands of asphalt felt. — Air. — Corrugated sheet, BO steel, 1.2 mm thick. — Sprayed on asbestos, 12 mm thick. — Frame.

Luggage compartment :

Crimped sheet, 1 mm thick. — Plywood, 15 mm thick. — Bands of asphalt felt. — Air. — Frame.

Toilet :

Vinyl carpet, 2 mm thick. — Rustless steel sheet, 0.5 mm thick. — Poplar panel. — Band of asphalt felt. — Air. — Corrugated sheet, BO steel 1.2 mm thick. — Frame.

TABLE 8.

Administrations	*Heating systems used*	*Applications*
S.N.C.B.	*a*) Water radiators using the engine cooling water (without regulation of the temperature in the compartments).	Light railcars for secondary lines buil prior to 1943.
	b) Pulsated air heated by means of exchangers fed by the engine cooling water.	Certain triple railcars built prio to 1940.
	c) Hot water radiators with oil burners (Westinghouse system); temperature of compartments regulated automatically by a thermostat acting on the burner.	All the simple railcars for secondar lines of recent construction (type 554-603-604-605).
	d) Pulsated air heated by oil burner (Westinghouse system). In summer, this system assures the ventilation (automatic regulation of the temperature as under *c*).	Most of the double and triple railcar (separate installations for each uni of the railcar).
Danish Railways	Steam (fully automatic oil burners installed on the railcars).	Series Mo and Mk-Fk railcars.
S.N.C.F.	Radiators with blowers (aerothermes) arranged under the seats, through which the engine cooling water runs.	Railcars for ordinary services.
	Pulsated air heated by means of exchangers under the body, supplied from the engine cooling water.	Fast railcars and the most recent rail-cars for ordinary services.
	Pulsated air heated by means of exchangers fed by the combustion gases of an oil burner.	Trailers for ordinary services and fast services.
Luxemburg Railways	Pulsated hot air - ventilation of the KUCKUCK system (the heating equipment is reversible and can be used for ventilation of the interior of the vehicle in the summer).	
N.S.	Oil burners helped by an effective system of ventilation.	DE 1 and DE 2 railcars.
	Air conditioning run from an auxiliary source of electricity supply.	TEE railcars.
C.F.P.	Pulsated air (heating and ventilation).	
Ö.B.B.	Pulsated air heated by the engine cooling water.	Series 5045 and 5145 railcars.
	Steam (fully automatic oil-fired boiler).	Series 5046 railcars.
	Hot air heated by oil (Webasto system).	Series 5080 railcars for stopping services
Algerian Railw.	Circulating hot water.	
F.S.	Pulsated air (heated by engine cooling water and by automatic naphtha boiler). Engine cooling water runs through the radiators.	In the case of the trailers, automatic naphtha boilers.
Finland	Air heated by the engine radiator to supplement the ordinary heating, preheating by Webasto boiler.	
Poland	Hot air and hot water. Each vehicle is heated separately.	

— heating by steam;
— heating by electricity.

The source of heat can be an oil burner in the case of the first three types, or the engine cooling water in the case of the first two.

As regards the advantages and drawbacks of these various systems, the Administrations reported their opinions, and some of them stated their preferences, according to circumstances.

In general, preference is given, at least in the case of the fast, main line railcars, to heating by pulsated air — making use either of a burner (S.N.C.B.) or the engine cooling water (S.N.C.F.).

In the case of railcars for ordinary services, some Administrations prefer to use hot water radiators, using either a burner (S.N.C.B.) or the engine cooling water (S.N.C.F.).

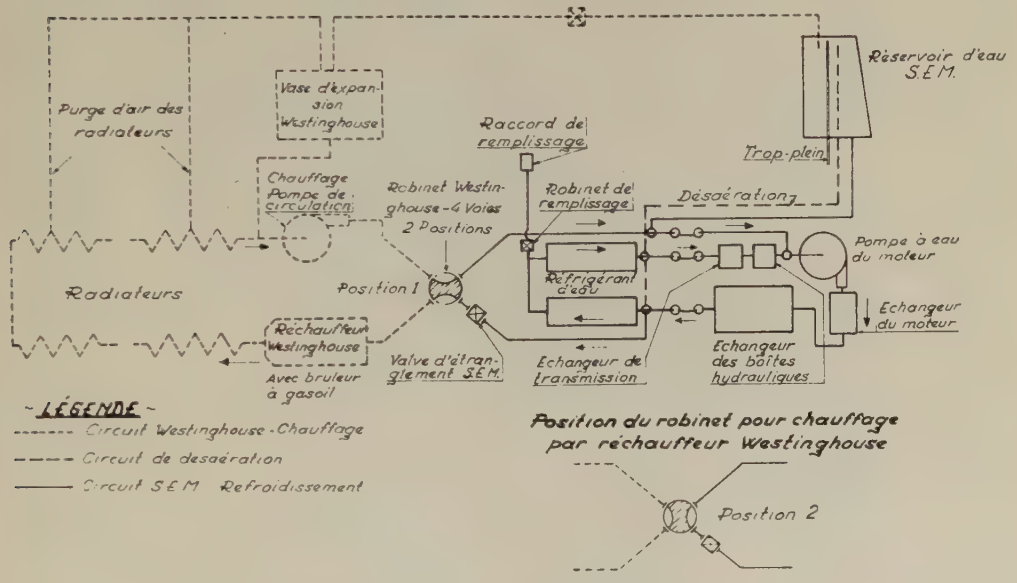


Fig. 52. — *S.N.C.B.* : Railcar 603. Water pipe installation. Heating by the diesel engine cooling water.

Explanation of French wording :

Légende = legend. — Circuit Westinghouse - chauffage = Westinghouse circuit - heating. — Circuit de désaération = air removal circuit. — Circuit S.E.M. - refroidissement = S.E.M. circuit - cooling. — Position du robinet pour chauffage par réchauffeur Westinghouse = Tap in position for heating by Westinghouse reheater. — Réservoir d'eau S.E.M. = S.E.M. water tank. — Purge d'air des radiateurs = air tap for radiators. — Vase d'expansion Westinghouse = Westinghouse expansion chamber. — Raccord de remplissage = filling connection. — Chauffage - pompe de circulation = heating - circulating pump. — Robinet Westinghouse - 4 voies - 2 positions = Westinghouse tap - 4 way - 2 position. — Robinet de remplissage - désaération = filling tap - air removal. — Trop-plein = too full. — Radiateurs = Radiators. — Réfrigérant d'eau = water cooler. — Pompe à eau du moteur = motor water pump. — Echangeur du moteur = Engine exchanger. — Réchauffeur Westinghouse avec brûleur à gasoil = Westinghouse reheater with oil burner. — Valve d'étranglement S.E.M. = S.E.M. cut out valve. — Echangeur de transmission = transmission exchanger. — Echangeur des boîtes hydrauliques = hydraulic boxes exchanger.

It is stressed in favour of the pulsated air system, that with this installation the air is renewed, and in summer it can be used to assure ventilation. Moreover no precautions have to be taken against freezing. However this system has the drawback of being more costly owing to the

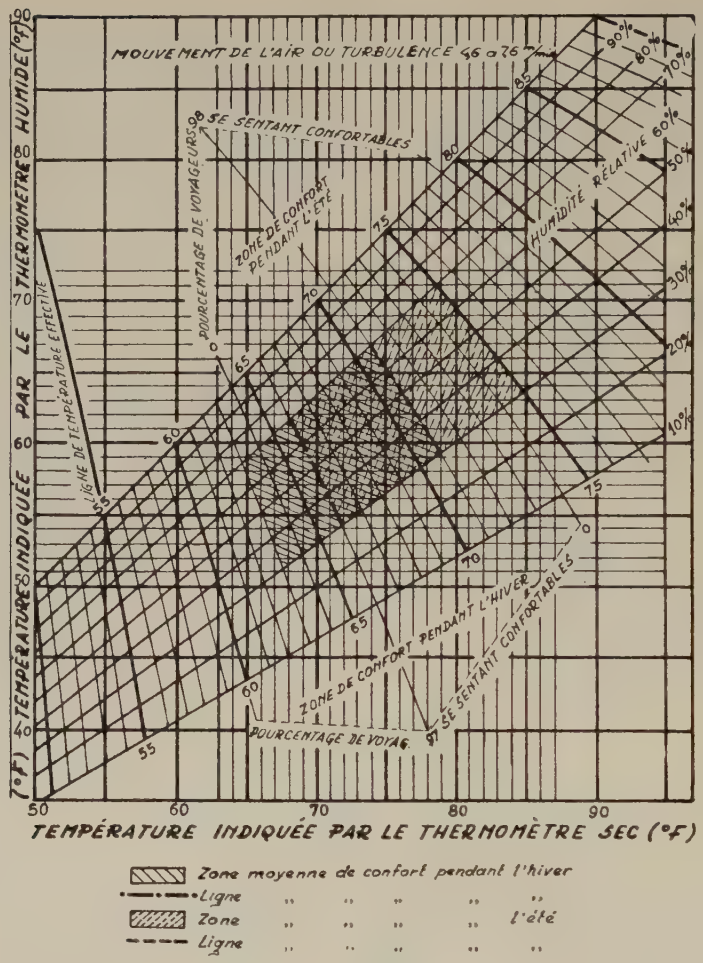

MOUVEMENT DE L'AIR OU TURBULENCE 46 a 76 m/m
98 SE SENTANT CONFORTABLES
POURCENTAGE DE VOYAGEURS
ZONE DE CONFORT PENDANT L'ÉTÉ
LIGNE DE TEMPÉRATURE EFFECTIVE
HUMIDITÉ RÉLATIVE 60%
ZONE DE CONFORT PENDANT L'HIVER
POURCENTAGE DE VOYAG.
97 SE SENTANT CONFORTABLES
TEMPÉRATURE INDIQUÉE PAR LE THERMOMÈTRE HUMIDE (°F)
TEMPÉRATURE INDIQUÉE PAR LE THERMOMÈTRE SEC (°F)
Zone moyenne de confort pendant l'hiver
Ligne " " " " "
Zone " " " " l'été
Ligne " " " " "

Fig. 53. — *C.F.P. :* Air conditioning. Comfort diagram. (Relations « Temperature relative humidity »).

Explanation of French wording :

Température indiquée par le thermomètre humide = temperature readings on the humid thermometer. — Mouvement de l'air ou turbulence = movement of air or draught. — Ligne de température effective = effective temperature line. — Pourcentage de voyageurs se sentant confortables = percentage of passengers who feel comfortable. — Zone de confort pendant l'été = zone of comfort during the summer. — Humidité relative = relative humidity. — Zone de confort pendant l'hiver = zone of comfort during the winter. — Pourcentage de voyageurs se sentant confortables = Percentage of passengers feeling comfortable. — Température indiquée par le thermomètre sec = temperature readings on the dry thermometer. — Zone moyenne de confort pendant l'hiver = average line of comfort during the winter. — Ligne moyenne de confort pendant l'hiver = average line of comfort during the winter. — Zone moyenne de confort pendant l'été = average zone of comfort during the summer. — Ligne moyenne de confort pendant l'été = average line of comfort during the summer.

necessary installations and the ducts required to bring in fresh air and evacuate the used air.

Heating by hot water radiators from the engine cooling water has the advantage of being the simplest system, but it has the drawbacks of being difficult to regulate, and sometimes does not give sufficient heat in cold weather.

The latter drawback is particularly great in the case of the early morning services, as there cannot be any preheating, so that it takes a long time to raise the temperature. In addition, this system has the serious defect of having an unfavourable effect on the temperature of the cooling water, which remains too low in the winter. It is however a possible system when the heating required is fairly low compared with the heat available in the water.

Heating by hot water radiators with an oil burner is considered as able to assure effective heating under all temperature conditions.

The heating circuit is sometimes connected to the engine cooling circuit by a tap (fig. 52) wich makes it possible :

— to use the installation for the preheating of the diesel engine;

— when the outside temperature is moderate, it may be possible to heat the railcar when necessary by the engine cooling water without using the oil burner.

The burners have two settings (strong/weak) and the temperature in the compartments is regulated automatically by means of a thermostat acting on the burner.

An identical type of regulation is used with the pulsated air heating system heated by an oil burner.

Hot water or hot air heating are usually independent installations for each car.

In view of the danger of freezing and the need to haul ordinary coaches with steam heating, this system of heating is stipulated by the Danish Railways who have used it in their most recent railcars. Completely automatic oil fired boilers have been fitted on these railcars.

In the same way, the Ö.B.B. stipulate steam heating for their large railcars which have to haul ordinary coaches with this type of heating.

Electric heating is, as a rule, only considered in the case of motor trains for luxury services, owing to its high cost.

The regulation of the temperature can take place automatically by thermostat (S.N.C.F., S.N.C.B., C.F.P., F.S.) or by hand, usually by the guard.

The temperature in the compartments varies between 17 and 20° C when the outside temperature is — 15 to 0° C travelling at speeds of between 80 and 140 km/h.

As far as ventilation is concerned, most railcars make use of fixed ventilators in the roof of the suction type. In general, all the windows can be opened by the passengers. The ventilating arrangements, depend, however, to a certain extent on the type of heating installation adopted.

One Railway stipulates in the case of railcars with hot water heating :

— the windows shall have sliding half frames in the upper portion fitted with extractors to assure ventilation without draught;

— in the vestibules and services compartments, fixed roof ventilators of the suction type.

In the case of railcars with pulsated air heating, the installation automatically assures the ventilation.

Air conditioning. — The Railways are unanimously of the opinion that the use of air conditioning on railcars can only be justified in moderate climates on fast long distance railcars for relatively luxurious services. Under these conditions, most of the railcars being used for internal services under temperate climatic conditions on the different railways do not include such installations, the weight, cost and maintenance of which are consider-

able. The Portuguese Railways consider with such installations the weight per passenger is increased by 12 to 15 % and the purchase price by 30 to 40 %.

As regards the general conditions for the working of air conditioning installations, the Netherlands Railways mention that the installation of air conditioning on the TEE rakes was based on a temperature range from — 15° to + 35° C. There is no special humidity regulation. The outside air is filtered and the filters are designed for moderate circumstances, i.e. for an atmosphere with a low dust content.

The Portuguese Railways state that the working of an air conditioning installation must meet the comfort demands shown in figure 53. These Railways use a « Stone-Carrier » air conditioning system on the Fiat railcar trains, which they have found satisfactory.

6. Shock and traction. Intercommunications.

Buffing and drawgear. — To make it possible to couple up an ordinary coach or locomotive in case of need to railcars, nearly all the Administrations prefer to use the same type of couplings on them as they use on their ordinary stock.

The S.N.C.F. after having made previous to 1948 an extensive use of automatic couplings suitable for railcars (light type Willison coupling), has gone back to a type of coupling with buffers and stretchers used on their ordinary stock, but using lighter components. In addition to the reasons given above, this Railway gave up using special couplings because they found that the absence of a buffer on the railcars led to too frequent damage during shunting in the stations and sheds.

The F.S. also uses couplings of the usual type of a lighter design.

On the other hand, the Netherlands Railways prefer the automatic coupling, and the Algerian Railways a standardised coupling for standard gauge and a Willison automatic coupling for narrow gauge lines.

The S.N.C.B. for their part stipulate :

a) for railcars that cannot be coupled together :
   — buffers of very reduced capacity (giving protection when running up against obstacles at low speed) ;
   — no actual drawgear, but simply an eye to which a chain or bar can be attached if the railcar breaks down;

b) for railcars that can only be coupled up to other railcars of the same type :
   — automatic central buffing and drawgear, with an additional emergency coupling so that if a railcar breaks down it can be moved by another vehicle with lateral buffers and drawgear;

c) for railcars that have to haul ordinary coaches or wagons :
   — the standard buffing and drawgear used on coaches.

The Ö.B.B. stipulate :

— in the case of the high class fast railcars, use of central buffing and drawgear of the Scharfenberg type or similar;

— for all other railcars, including those used for stopping services, the use of the standard buffing and drawgear so that they can be coupled up to ordinary coaches or wagons. This Administration considers this system favours a well-balanced utilisation of railcars on secondary lines.

Intercommunications. — As regards the provision of intercommunication between motor units and between such units and the vehicles they are hauling — pneumatic, electric and heating connections and means of allowing passengers to move from vehicle to vehicle — there are two cases to be considered according to the data supplied by the Railways :

a) the case of railcars used for ordinary

or fast services fitted with the standard type of buffing and drawgear, which are frequently used on secondary lines and haul ordinary coaches or wagons, and

b) the case of railcars fitted with automatic centre couplings.

In the first case, for reasons of economy or design, the railcars and trailers used in ordinary service by a certain number of Administrations have no gangways or bellows allowing passengers to move from vehicle to vehicle.

On the Danish Railways, however, gangways are provided between the railcars and the ordinary coaches they are hauling.

The Ö.B.B. are of the opinion that gangways are not needed by passengers when railcars haul ordinary coaches, and merely provide as a result a simple open gangway protected at the side for the use of the staff.

As regards other systems of intercommunication, connections of the standard type, pneumatic, electric, remote control and heating connections, are used in the first case according to circumstances. In the second case (railcars with automatic centre coupling), such connections have to be joined up with this coupling, as the Administrations generally stipulate.

In particular, railcars for fast services, which usually are multiple units, have gangways and bellows between the units so that passengers can pass from one to the other (sometimes also to conserve the streamlining). For remote control of the engine fuel, compressed air is generally used. This system has certain drawbacks in the case of rather long railcar rakes (more than 4 units), so that on the most recent S.N.C.F. stock, there is electric control with spaced notches.

* * *

D. Cost of operating railcars.

The Administrations were asked to give the cost per 1 000 axle-km (or per 1 000 t-km) in their national currency and in U.S.A. dollars for their existing railcar services, and to break down this price into percentages under the headings of : sinking fund, fuel, staff, maintenance and repair.

In Tables 9 and 10, we have collected together the replies received respectively from the European and non-European Administrations.

It will be noted that the S.N.C.F. supplied the data asked for on the basis of 1 000 t-km and Togo on the basis of the km.

An analysis of these data under the different headings shows that out of the total cost of operating railcars, it is the cost of fuel that is the lowest, and the heaviest are — and to a decisive degree — the cost of maintenance and repairs.

The improvements to be made in the mechanical equipment of railcars should therefore make it possible to increase the mileage run between repairs, in order to make economies under this heading.

However, the tendency to increase the general comfort of railcars is likely to wipe out such economies.

* * *

III. CONCLUSIONS.

It must be remembered that the foregoing Report relates to the position on 18 Administrations listed in Table 1 : 12 European Administrations, 5 African and 1 Asian.

In the 1st Part, as an Introduction, we gave certain numerical data concerning the railways and the use of diesel traction, as well as descriptive details of 39 postwar railcars (railcars built between 1st January 1946 and 1st January 1957, under construction or on the drawing board).

In the 2nd Part, we have examined on the basis of the various questions of the proposed theme, the technique of construction and general arrangement of the equipment adopted on these railcars, and we have endeavoured to express in this con-

TABLE 9.

Cost of operating railcars.

European Administrations	*Cost per 1 000 axle/km*			*Percentage under the different headings*						*Remarks*
	in national currency		in U.S.A. dollars	Fuel	Driving	Miscellaneous shed a. other services	Maintenance and repairs	Sinking fund	Social charges	
S.N.C.B.										
I Light four wheeled railcars for secondary lines (125 HP)	Belg. francs	6 100	122	5	21	12	27	13	22	These costs include the direct operating costs (labour and materials) including general depot costs; renewal costs (sinking fund); social charges in connection with the staff and general administrative costs (about 50 % of wages).
II Light bogie railcars for secondary lines (165 HP)	»	3 100	62	7	18	10	29	16	20	
III Single unit railcars (350 to 400 HP)	»	4 100	82	12	13	10	29	19	17	
IV Double railcars for internal services with three bogies (6 axles) $2 \times 370 = 740$ HP. .	»	3 650	73	12	10	9	32	21	16	
N.S.										
a) DE 1/2 rakes . . .	Dutch florins	161.78	—	—	—	—	—	—	—	
b) DE 3/5 rakes :										
pre-war rakes . . .	»	120.19	—	—	—	—	—	—	—	
the two combined . .	»	134.74	35.46	13.5	20.6	—	34.8	31.1	—	
Luxemburg	Lux. francs	2 435	47.80	—	—	—	—	—	—	

TABLE 9.

Cost of operating railcars *(continued)*.

European Administrations	*Cost per 1 000 axle/km*			*Percentage under the different headings*						*Remarks*
	in national currency		in U.S.A. dollars	Fuel	Driving	Miscellaneous shed a. other services	Maintenance and repairs	Sinking fund	Social charges	
F. S.										
Railcar 772	lires	45 000	71.8	6	29	—	~ 41	24	—	
» 772 + 1 trailer	»	—	- -	—	- -	—	—	—	—	
» 990	»	58 000	92.8	5	22		48	25	—	
» 990 + 1 trailer	»	36 000	57.5	5	18	—	47	30	—	Fuel : naphtha (exempt from customs dues).
» 880	»	63 000	100.2	5	20	—	51	24	—	
» 880 + 1 trailer	»	39 000	62.4	5	16	—	50	29	—	Service : worked with one driver and one driver's assistant.
» 773	»	48 000	76.6	6	27	—	40	27	—	
» 773 + 1 trailer	»	29 000	46.3	6	22	—	38	34	—	
» 668	»	41 000	65.6	6	31	—	40	23	—	
» 668 + 1 trailer	»	25 000	40	6	26	—	40	28	—	
	Cost per 1 000 gross t/km									(*a*) Average cost based on a revaluation of the kilometric costs for the year 1955. (*b*) includ. lubrificat. (*c*) at 5 % ov. 25 years
	in national currency		in U.S.A. dollars							
S.N.C.F.	French francs	3 460 (*a*)	9.89	7 (*b*)	22	—	53	18 (*c*)	—	

TABLE 10.

Cost of operating railcars.

Non-European Administrations	*Cost per 1 000 axle/km*			*Percentage under the different headings*						*Remarks*
	in national currency		in U.S.A. dollars	Fuel	Driving	Miscellaneous shed and other services	Maintenance and repairs	Sinking fund	Social charges	
Algeria	—	—	—	11.5	13.5	—	66	9	—	
Cameroons	CFA frs.	127 000	—	9	11.8	—	50.2 (*d*)	29	—	(*d*) Including general service charges
Cambodia	riels	1 573	45	28.2	16	—	55.8	—	—	
Togo	Kilometric cost of ABJ railcars whose sinking fund period is 15 years : — fuel and oil, per km 12 to 13 CFA frs.; — staff for driving, per km 8 to 9 CFA frs.; maintenance and repairs, per km approximately 70 CFA frs.									

nection the ideas and opinions of the Administrations.

Before we drawn up our final summaries in this last Part of the Report, we think it would be useful to give below a resumé of these ideas and opinions.

a) *Object of using railcars.* — The use of railcars is dictated by reasons of economy, flexibility of working, rapidity and comfort. Railcars are therefore an operating instrument which make it possible to improve the service and meet the competition of road transport.

However, their field of use is generally restricted to passenger services of moderate intensity, where the amount of traffic does not justify running ordinary trains.

In general, it can be said that — either running as single units or with trailers (special trailers or ordinary coaches) or as multiple units with centralised control so that they form railcar trains, the composition of which does not as a rule exceed 4 units — railcars can be adapted within their field of use to varying circumstances and assure :

— stopping services;
— connecting services on secondary lines where they link up with the main lines;
— fast, direct, or semi-direct services, over average and long distances, in particular international services.

On certain lines which have not been entirely dieselised, railcars may work all or nearly all the passenger traffic, freight traffic being worked by steam traction.

The trains can be made up in such a way that 450 passengers can be carried (2 motor units + 2 trailers).

In the case of sudden peak traffic on dieselised lines, it is generally better to run a train hauled by a diesel locomotive than multiply the number of railcar services.

b) *Standardisation of railcars.* — For reasons of economy — better user of the vehicles, reduction of spares, specialisation of train staff and workmen, lower purchase price of units and spares — all Administrations stipulate standardisation of railcars. In general, they are all proposing to have a smaller number of different types of railcar in the future than at the present time, to the greatest possible extent.

Such standardisation covers in particular the types of engines and transmissions, with a tendency towards the standardisation of certain equipment only, rather than the whole unit.

c) *Motor equipment.* — In view of the high technical level reached in the design of modern engines, most of the Administrations, for reasons of economy and simplicity, prefer one engine per railcar, rather than two engines of lower power.

Quick-revolution engines (1 400-1 800 r.p.m.), 4 stroke (very often supercharged) are preferred by the Administrations. Engines whose power does not exceed 500 HP are preferably housed under the body (sometimes on the bogies).

In the case of higher powers, certain Railways stipulate that the engine shall be housed in the body, in view of the complication of housing a powerful engine under the body or on the bogies.

Treatment of the engine cooling water is the general practice on most of the Railways to prevent scale and corrosion. However, such treatment is not used systematically by certain Administrations for all their railcar engines but only in the case of certain types.

As regards types of transmission, the Railways prefer, almost unanimously, mechanical drives for powers not exceeding about 300 HP. In the case of higher powers, opinions are divided. Certain Administrations prefer hydraulic drives to electric drives because their purchase price is lower, and they are lighter and less bulky, making it possible to reduce the non-suspended weight.

Other Administrations, however, prefer

electric drives for reasons of simplicity of driving, regularity of working, and simplification and economy of maintenance, in spite of the greater weight and higher cost of these transmissions.

From the point of view of performances, there does not appear to be much difference between the two types.

It may be mentioned that in the case of the 39 types of railcars described in the Introduction (Tables 4*a*, 4*b* and 4*c*), the different systems of drive used are divided up as follows :

— mechanical drive, on 15 types of railcars, having engines of powers between 110 and 500 HP;

— hydromechanical or hydraulic drives, on 18 types of railcars having engines of powers between 137 and 825 HP;

— electric drive on 6 types of railcars having engines of powers between 140 and 1 000 HP.

In the case of electric drives, the traction motors are generally nose-suspended.

d) *Body, bogie and suspension.* — Welded construction in ordinary steel, of light weight or standard, very often of folded sheet, are generally the solutions specified for the framework of the body. For the interior and exterior covering of the body steel, aluminium or aluminium alloy sheets are used.

Certain Railways stipulate the use of rustless steel for fast, long distance railcars.

The bogies are generally built of rolled sections or formed by welding, assembly being by welding or welding and riveting combined. The use of cast steel is also considered.

Wheel sets with plain axles and wheels with tyres having cylindrical bearings are the most generally used.

Various designs are used for the primary and secondary suspension.

In order to improve the running qualities of railcars, certain Administrations stipulate : the use of coiled springs in both the primary and secondary suspension; a primary suspension with boxes without slides and excluding all longitudinal and transversal play; secondary suspension with hydraulic shock absorbers; the transversal displacement of the body controlled by the rods of the secondary suspension, the springs and the hydraulic shock absorbers; the absence of rubbing surfaces in the suspensions and pivots; siting the bogie pivots in line with the axles; the recall of the bogie from rotation by the inclination given to the rods of the secondary suspension.

e) *Weight reduction.* — It may be stated that only a relatively small number of the railcars built between 1st January 1946 and 1st January 1957 can be considered as having a light weight construction.

Certain Administrations are considering going further in the field of weight reduction, especially as regards railcars for suburban services and secondary lines.

In the case of long distance railcars, the opinion is held that weight reduction should be judiciously limited, especially for reasons of comfort.

The Administrations consider that attempts to reduce the weight should concern above all those parts which play no part in the safety, and that particular attention should be given to the question of reducing the weight of the bogies and of the non-suspended parts of the springs.

In order to reduce the weight of the body, they mention :

— in the framework, a judicious use of sections made of folded sheets, of pressings (in the case of large series), the use of roofs made of lights alloys, and the generalisation of welded assemblies;

— for the interior arrangement, as extensive a use as possible of aluminium alloys and plastic materials.

The objectives the Administrations have in view when studying weight reduction are, according to circumstances :

— a reduction in the power installed;
— reduction of purchase price and maintenance costs;
— improvement of the running on lines with steep gradients (20-30 $^{0}/_{00}$);
— lower axle loads with the possibility of using the railcars on secondary lines having a light superstructure.

In the case of railcars of normal construction, the power/weight ratio varies from 5 HP/t (railcars for local services running on lines with an easy profile) to 10 HP/t (railcars for fast services) according to the information supplied by the Administrations.

The weight per seat of the railcars described in the Introduction varies from 400 kg (average for railcars intended for local services) to about 1 000 kg for the double TEE rakes. In the case of the four unit TEE rakes with air conditioning, this weight amounts to 1 900 kg.

f) *Soundproofing.* — Soundproofing has not been systematically undertaken on all the railcars which we have considered. A certain number of them have no soundproofing or only partial.

However, the Administrations consider that in general soundproofing should be aimed at in the future by isolating all railcars of no matter what category, so that the comfort of the passenger approximates the standard on ordinary coaches.

In the technique of soundproofing, apart from the appropriate use of soundproofing materials in the walls and ceiling, the construction of the floor and windows requires special attention. A floor of increased thickness or a false-floor (with no rigid connections with the walls) of suitable design, are used as an important soundproofing measure.

Perfect soundproofing naturally implies avoiding any openings in the body to the outside atmosphere. In this connection, soundproofing is facilitated in the case of the luxury railcars equipped with air conditioning (fixed windows).

As regards reducing engine noises, in particular those of the exhaust, the Railways generally stipulate, in addition to the usual soundproofing measures, the use of silencers on non-supercharged engines.

Mounting the engines in or under the body also requires particular attention.

It will be appreciated that effective soundproofing adds considerably to the weight of the vehicle.

g) *Heating, ventilation and air conditioning.* — According to the criteria used by the Administrations, four different heating systems are used :

— heating by pulsated air;
— heating by hot water
(the source of heat in both cases may be either an oil burner on the engine cooling water);
— heating by steam (source of heat, an oil burner);
— heating by electricity.

In general, the first system is preferred for fast, long distance railcars.

For railcars intended for ordinary services hot water heating (radiators) is most often used.

When the water is heated by a burner, the heating circuit is sometimes connected up with the engine cooling water circuit.

Steam heating is used in particular in cases where the railcars have to haul ordinary coaches equipped with this type of heating. A fully automatic oilfired boiler is then fitted on the railcars.

Electric heating is as a general rule only used on the luxury railcars (for example the TEE of the N.S. or the C.F.P. triple My 501/506 railcar).

As a general rule, each unit has its own heating installation for hot water or hot air heating.

Ventilation is assured on most railcars by the fixed suction type ventilators in the roofs, and generally all the windows can be opened by the passengers.

As regards air conditioning, the Administrations are unanimously of the opinion that its use on railcars running in countries with a temperate climate can only be justified in the case of fast, long distance railcars and luxury rakes.

In fact, only a very small number of the railcars we have examined are fitted with air conditioning.

h) *Buffing drawgear. — Intercommunications.* — As a general, rule, the Administrations prefer to use on their railcars the same type of coupling as used on their ordinary stock, but using lighter components.

This arrangement which makes it possible to couple up a relief locomotive is used especially in the case of railcars for local services, or those which have to haul ordinary coaches or wagons.

However, certain Administrations prefer to use an automatic centre coupling, in particular in the case of the important fast railcars, or railcars that can only be coupled up with other railcars of the same type. In this case, there is also an emergency coupling that can be used to move the vehicle in case of breakdown.

As regards intercommunication arrangements, gangways and bellows to allow passengers to move from coach to coach (and sometimes for streamlining) are generally used in the case of the fast railcars, between the various units of the rakes.

In the case of railcars intended for use in stopping services on local lines, certain Administrations think it is unnecessary to provide any arrangements to allow passengers to move from coach to coach.

The pneumatic, electric and heating connections, with which intercommunication is also concerned, will be of the normal type in the case of railcars equipped with the same buffing and drawgear as the ordinary stock.

On the other hand, in those cases where a centre automatic coupling is used, all the connections must be combined together in this coupling.

i) *Cost of operating railcars.* — The analysis of the constituent parts of the costs per 1 000 km-axle supplied by the Administrations concerning their railcar services, shows that the repair and maintenance costs represent 30 to 50 % of the total expenditures and that they are the heaviest in the total cost of operating railcars.

The lowest costs are those relating to fuel, which in general are not above 12 %.

In order to realise same savings in the operating of railcars, the improvements to be made to the mechanical equipment of these vehicles must permit the increase of the mileage run between maintenance and repair and also to make the latter more economical.

* * *

Although, as we have pointed out, the ideas and opinions of the Administrations which we have summed up above are not always identical in the case of certain items of the theme under consideration, it will however be recognised that under these ideas and opinions, all the Administrations are pursuing the same objectives : on the one hand, they are trying to find a more and more economical method of working their railcar services, in particular by reducing maintenance and repair costs; on the other hand, they are doing all in their power to improve the quality of these services, especially as regards the standard of comfort offered passengers

It is possible however that the measures taken in connection with this latter objective may cancel out any economies that may be made in operating the railcars.

It is naturally the characteristics of the traffic on the different Railways, the individual ideas of the Administrations, and the industrial and economic conditions of their respective countries, as well as the kind of railcar services under consideration that will determine in each particular case to what exent and by what means economic operation and improved railcar services can be achieved.

However, if we take railcars intended for ordinary services and important railcars intended for fast long distance services or international services, separately, we think it possible to put forward the following final summaries on this subject as representative of the general ideas of the Administrations :

1. Administrations using railcars for moderate services, for reasons of economy, flexibility of working, speed and the comfort of the passenger.
   They stipulate :

   a) *As measures favouring an ecomic operation :*

2. Standardisation of the railcars aimed at a reduction in the number of different types, engines, and drives, and the interchangeability of a certain number of components for the body, bogies and auxiliary parts (radiators, fans, compressors, etc.).

3. Treating the engine cooling water, in particular against scale and corrosion.

   b) *As constructional ideas :*

4. The motor equipment to consist of :
   - — a single engine per motor unit, fast-rev. and 4 stroke, and often supercharged (fitting the engine under the body in the case of powers of not more than 500 HP and in the body in the case of higher powers) ;
   - — mechanical drive for powers not exceeding about 300 HP;
   - — « fluid » transmissions — hydromechanical, hydraulic, or electric — in the case of powers above this figure.

5. Welded construction in ordinary steel for the body and bogies, and particularly light weight in the case of railcars intended for suburban services or services on secondary lines (weight reduction, obtained as indicated under *e* in the resumé above will however be judiciously restricted in the case of railcars intended for fast, long runs for reasons of comfort) ;

6. The use, in general, of the same buffing and drawgear as is used on the ordinary stock, although lighter in weight, especially in the case of railcars intended for ordinary services :
   - — the use of an automatic centre coupling in certain cases, in particular for some of the high class fast railcars or railcars which are only coupled up with other railcars of the same type;

   c) *As measures to increase the comfort of passengers :*

7. Soundproofing, in general in the case of all types of railcars.

8. Heating by pulsated air (which also assures ventilation in the summer) is preferable in the case of fast, long distance railcars; and hot water heating (radiators) for railcars intended for local services; in both cases, the source of heat can be either the engine cooling water or an oil burner (in the case of trailers in general individual installations with a burner are provided) :
   - — electric heating, is used exceptionally in the case of luxury railcars;
   - — steam heating is limited to railcars which haul coaches equipped with this type of heating.

9. Air conditioning is limited to luxury railcars in countries having a temperate climate.

10. An intercommunication system for passengers, which sometimes includes streamlining arrangements is generally provided in the case of fast, long distance railcars.

11. The design of the primary and

secondary suspensions making it possible to improve the running qualities of railcars as indicated under *d*) in the above resumé.

* * *

We apologise if we have been too detailed in our report.

It is however only a partial report which we have drawn up with care in order to make it as representative as possible of the position for the group of Administrations for whom we have had the honour of being Reporter.

Porto, December 1957.

[625 .28 (42) & 656 .25 (42)]

Railway modernisation — Signalling.

(Extracted from the « *Engineering*, », November 8, 1957).

In the late afternoon of December 10, 1937, an express from Edinburgh to Glasgow overran the home signal at Castlecary station, Dumbartonshire, and collided at about 60 m.p.h. with a Dundee-Glasgow express which was standing in the station. The accident caused the deaths of 35 passengers and injuries to 179 others. It took place an hour after sunset in falling snow. In the subsequent Ministry of Transport report on the accident the Chief Inspecting Officer, Railways, recommended that the subject of automatic train control as a precaution against failure to observe or comply with signals should be considered further without delay.

S.G.E. type « L.C. » searchlight signal installed at Chelmsford in connection with the Shenfield-Chelmsford electrification.

By the outbreak of war in 1939 a beginning had been made with the installation of a magnetic automatic train control system on the Edinburgh-Glasgow main line, similar to that then in experimental use on most of the London Tilbury & Southend section of the L.M.S.R. After the war the L.T. & S. installation was brought into full operational service one month before nationalisation, but the new railway organisation of January 1, 1948, made it necessary to select a standard system suitable for application throughout British Railways. Studies were therefore directed to combining the best features of the magnetic system and of the ramp contact system which was already in use on all the principal routes of the Great Western Railway and had seen over 40 years' service.

While these studies were going forward, the Harrow collision of October 8, 1952, with a death roll of 112, once more brought the subject of automatic train control sharply into the public mind, for the Ministry of Transport inquiry found that the overrunning of signals by the up Perth sleeping-car express had been the primary cause of its colliding with the rear of the local train which was just leaving Harrow and Wealdstone station. It may be recalled that immediately after this collision, a down Manchester and Liverpool express ran into the wreckage of the two trains, although in this case there was no question of signals being overrun and automatic train control could not have prevented this further accident.

Ten days after the Harrow accident the Railway Executive made it known that tests of A.T.C. equipment had been in progress for four years, and that trial apparatus had been installed on the Eastern Region on the down main line from Kings Cross between New Barnet and Huntingdon. A number of main-line locomotives had been equipped for using the system.

route, together with some 10 000 locomotives, by the end of 1962. This programme covers : Kings Cross to Edimburgh via Newcastle; Euston to Glasgow (including Manchester and Liverpool); Edinburgh to Glasgow; Waterloo to Bournemouth and Exeter; and Liverpool Street to Norwich.

The form of A.T.C. chosen is described as a warning system. It is associated

The simplicity of colour-light signalling and route indicators is contrasted with semaphore brackets and gantrys in this view showing re-signalling at Bricklayers Arms, Southern Region.

When the modernisation plan was published in 1955, an expenditure of £ 20 million was assumed on the programme for the introduction of automatic train control, or about one-fifth of the total sum estimated for signalling and tele-communications as a whole. Final approval to the form of A.T.C. selected by the British Transport Commission was given by the Minister of Transport in November, 1956. This system is now installed on 210 track-miles, and plans to provide the equipment on all main traffic routes are being pressed ahead. It is the intention to equip some 1 300 miles of

with distant and multiple-aspect signals and gives different audible indications for the « caution » and « clear » aspects. In the event of the signal being at « caution » a brake application is initiated after a brief delay if no action is taken by the driver, but normally he acknowledges a warning by cancelling the action of the apparatus and retaining control of the train himself. This interpretation of automatic train control as a warning device is in accordance with the principle accepted in 1927 by the Automatic Train Control Committee. It will be seen, therefore, that the question has been considered

over a long period, but the expense of large-scale installations and the various types of accidents against which A.T.C. gives no protection, but which may have destructive and costly consequences, have retarded decisions in the past.

While not in general involving changes of practice as fundamental as those of the electrification and Diesel programmes, for relay interlocking systems such as are now generally adopted have been used at various places since the 1930s, signalling is an essential background to the operation of faster and more frequent trains by new motive power. The replacement of semaphore signals by colour-lights and the concentration of working in fewer signal boxes have been going on at individual locations and over large areas as part of normal post-war rehabilitation. The re-signalling schemes at York and Cowlairs (Glasgow) are examples of the application of route-relay interlocking to busy traffic centres, that at York being the largest relay interlocking in the world. The colour-light signalling on the Brighton main line of the Southern Region typifies the extension of modern facilities to a complete route. This scheme, carried out in four stages between 1950 and 1955, replaced semaphore signalling between Coulsdon North and the approaches to London Bridge and Victoria, so that colour-lights are now continuous between these termini and Brighton.

General view of the operating floor of the new St. Pancras signalbox, showing (right) the operating console with its 205 route setting switches and (left) the train recorder's telephone concentrator. Above the console is the illuminated track diagram.

Current schemes do not always involve the complete replacement of mechanical control by electrical methods, but the two may be combined according to the economics of individual cases. On the Western Region, for example, a new 71-lever mechanical frame was put in at West Ealing in 1955 in connection with the changeover from searchlight to multi-

aspect colour-light signals between Paddington and Southall. At this box, the frame controls points and certain semaphore signals still in use, while above it is a relay control panel for the operation of colour-light signals and certain power-operated points too far from the box for mechanical control. There is a similar combination of electrical and mechanical methods in the re-signalling of the Glasgow low-level lines completed in 1956, where at two boxes point levers have been retained in conjunction with relay control panels for the colour-lights, operation of the panel key switches being arranged to effect the normal interlocking through electric locks applied to the lever frames instead of by locking bars. At other places mechanical semaphore signalling has been retained but additional track circuits and electrical controls have been provided.

Further orders have been placed for V.H.F. radio equipment to provide communication between marshalling yard staff and the drivers or Diesel shunting locomotives. The enclosed cab and higher noise level in a Diesel shunter make it likely that this method of passing instructions will gain ground compared with the use of loud-speakers. Other marshalling yard modernisation plans include the installation of railbrakes with electronic controls to measure the speed of wagons running off the hump, and to apply braking pressure accordingly. Considerable study has been directed to methods of recording the passage of wagons through marshalling yards and storing the information.

A comparison of the old and new style of signalboxes is shown at Dock Junction—just outside St. Pancras station.

Improvements in signalling and associated techniques are being accompanied by modernisation of the railways' own communication system, largely by the use of multi-channel, voice-frequency methods to provide maximum capacity on a given circuit. Possibilities in this direction have been increased by the introduction of relatively simple systems enabling the principle to be used over existing line wires in rural areas.

The modernisation plan envisaged the

use of centralised train control systems for remote control of signals and points on long single-track routes. This method of working is being developed in several countries overseas, both as full C.T.C., in which the route is continuously track-circuited, and in a modified form under which shorter sections of line, such as passing loops at stations, are controlled from a remote point. It has now been announced that remote control methods will be used for signalling the Sheerness branch of the Southern Region in connection with the re-signalling of the area necessitated by the East Kent electrification scheme, while full C.T.C. is to be provided between Perth and Inverness.

Important re-signaling projects announced since publication of the modernisation plan include St. Pancras (completed this month), Newcastle, Glasgow (Central), Huddersfield and Perth. Good progress has been made with the re-signalling of the approaches to the replanned marshalling yard at Temple Mills, Stratford, where considerable economies and improvement in the speed of handling traffic are expected from the concentration into one main and two reservoir yards of work previously carried out in 15 yards.

General.

When the Commission's plans for automatic train control were announced, there was a body of opinion which favoured retaining the system already at work in the Western Region. This system had been shown capable of adaptation to the double-yellow aspect, which was not in force when A.T.C. was first introduced by the Great Western Railway. There is inconvenience, however, in the use of a ramp between the rails, and physical contact with a moving locomotive which must not only allow an electric current to flow but raise and lower a shoe under the locomotive. Although snow or ice might give the effect of a non-energised ramp, which causes the « caution » signal to be sounded, a succession of spurious cautions might lead to a genuine signal being disregarded. Again, if icing causes the locomotive shoe to remain raised after clearing the ramp, the « caution » signal may be sounded continuously, and this introduces the temptation to isolate the apparatus in severe weather conditions, which may be the occasion when its warnings are most needed. Recent development in A.T.C. in other countries has all been in the direction of inductive systems requiring no physical contact between the locomotive and track apparatus, and the magnetic link chosen by the B.T.C. conforms with this trend while allowing development to proceed from a point where operating experience has been gained already in this country. A complication probably unforeseen in 1948, however, is the fact that track inductor magnets will be required on 25 kV/6:6 kV alternating-current lines to initiate automatic changeover of connections between the two voltages in locomotives as well as for signalling, and that there must be no possibility of interaction between the two systems.

The B.T.C. system follows Great Western practice in having separate siren and bell signals for « caution » and « clear » instead of long and short blasts on the siren, but the magnetic link is derived from the Tilbury line installation. A local power supply will be used on the vehicles, as was done on the G.W.R. In the original Tilbury line equipments the deflection of an armature in a magnetic receiver when passing over a track magnet acted directly on the brake valve, but later this system, also, was modified so that the armature simply operated contacts in a local power circuit on the locomotive. To ensure immunisation of electric locomotive A.T.C. equipment from alternating traction current effects, a motor-alternator operated from the locomotive supply has been designed to provide an alternating current output at 600 cycles which will be transformed and rectified for operating

the A.T.C. relays. Modifications have also been made to the type of indicator originally fitted with the Tilbury line A.T.C. equipment to remind a driver when he has acknowledged a caution signal and assumed control of the braking.

Up to and including the time of the Brighton line colour-light signalling schemes of 1950-1955, the Southern Region was using miniature-lever power frames in signal boxes. Recent contracts for re-signalling on the East Kent lines show that route-relay control panels are now being adopted, which follows practice in recent large installations in other Regions. Considerable variety continues in the methods by which a route is set up. Sometimes two key switches, or a switch and a pushbutton, have to be operated. Alternatively there may be a separate switch for each route, or there may be one switch and a rotary route selector. Controls may be mounted on the track diagram itself or on a console in front of it. The route diagram may show a series of white lights for a route set up, or indications may be confined to showing which way the points are lying. Railway signal engineers appear to differ in their views as to the merits of various practices, and signalling contractors, while their own engineers have their personal views, would not be human if they did not give their customers what they want.

While variety persists, however, there are signs that, outside the signal box, electro-pneumatic operation of points will often be preferred to all-electric working, although the latter method continues to improve in speed of action and at one time claimed easier maintenance. Of recent schemes, York, Cowlairs, Dumfries and St. Pancras have used single individual switches for controlling the signals and points applying to particular routes, but the panel to be supplied for Perth will involve the operation of two switches per route, located on the track diagram in the positions corresponding to its beginning and end. The new signal box recently commissioned at Dumfries station is representative of the combinations of mechanical and electrical working still being employed, a mechanical frame being provided for working points near the box, and key switches for controlling colour-light signals and the more distant points.

The essential in signaling is to present drivers with unambiguous indications by day and night on any routes they cover, and the spread of colour-light schemes is contributing to this purpose. This is well exhibited by the multi-lamp junction indicator which enables one set of colour-light aspects to cover several routes.

NEW BOOKS AND PUBLICATIONS.

[385 (08 (42)]

London Transport in 1956. — Report of the London Transport Executive. — One volume ($6\frac{1}{2}'' \times 9''$), 122 pages, with illustrations and numerous tables. — 1957, London. London Transport Executive, 55 Broadway, Westminster, S.W.1.

The annual report of the London Transport Executive is deserving of close attention, in view of the important activities in the field of public transport of that undertaking, which carries daily about 11 million passengers, which owned, at the end of 1956, 4 026 railway vehicles and 9 407 road vehicles, and which employs more than 87 000 people.

In the introductory chapter in which the salient facts pertaining to the year 1956 are recalled, the report again draws attention to the problems of traffic congestion in central London, caused by the incessant increase in the number of private cars, and emphasizes the noticeable improvements in the regularity and speed of the road services as a result of petrol rationing in December 1956 when private motor traffic was reduced to a minimum. The report lends full support to the official proposals for the control of parking in central London and for the staggering of hours of work. The report also reiterates the conviction that the construction of the Victoria Line would bring about a noticeable improvement in the present position. The technical planning of this line has been going forward during the year 1956 but the means of financing the expenditure must still be settled.

Chapters II and III are concerned with traffic and services, respectively. The reason for the decline in traffic which is particularly noticeable on the road services serving the central area and inner suburbs are discussed in detail. The improvements made to various services, improved regularity, extensions and modifications of routes, creation of new suburban routes, extension of one-man operation are likewise emphasized.

Chapter IV gives the reasons for the fares increases which took place in 1956. It also reports the success of certain cheap fare facilities which had been introduced in 1955 and were again introduced in 1956.

Chapter V analyzes the causes of the adverse financial results for the year 1956. These are mainly due to rising wages and price levels on the one hand, and to the continued downward trend in traffic on the road services on the other hand. It has not been possible to balance these factors by the fares increases which came into force in 1956, and by the savings in operation.

Chapter VII deals with the improvements to fixed installations and rolling stock. It reports, in particular, the official opening of a new bus overhaul works at Aldenham which can deal with 45 vehicles per week, and the commencement of experimental running in passenger service of prototypes of the new buses which are destined to replace the trolleybuses. These buses will be assembled from standardized and easily interchangeable components. On the railway side, the report mentions numerous track rearrangement, electrification and signalling works.

An important chapter is devoted to the recruitment and training of staff, to rates of pay and staff welfare organisation.

Finally, in keeping with a long-established tradition, the report concludes with the study of a problem of topical interest in the field of public transport. The subject chosen this year is the study of office development in central London, and of its effect on public transport in that area.

The report is supplemented by detailed statements concerning the working results, assets and financial position of the undertaking.

R. S.

[385 (08 (460)]

RED NACIONAL DE LOS FERROCARRILES ESPAÑOLES. — Memoria del Consejo de Administracion. Ejercicio de 1956 *(Report of the Administrative Council for the year 1956)*. — One volume (8 1/4 × 11 1/2 in.) of 169 pages with illustrations and numerous tables. — Madrid, Sucesores de Rivadeneyra, S.A., Paseo de Onesimo Redondo, 26.

The annual report for the year 1956 shows at once that during its last years working the RENFE had a considerable increase in its traffic units: the number of passenger-kilometres at 8 550 millions reached the maximum ever recorded (an increase of 6.63 % over 1955); but the number of tonne-kilometres, although it did not reach the absolute maximum of 1953, at 7 700 millions also showed an increase of more than 6 % compared with the previous year (1955). The slow goods traffic, however, showed a slight decline.

This fortunate result, however, in spite of the great hopes pinned upon it, did not bring about a balancing of receipts and expenditures, the operating coefficient being 123 %, not taking sinking fund charges into account. Though the expected increase in traffic was largely attained, on the other hand, the increase in costs was even greater: in effect the wage increases in April and then the regulation of working conditions imposed in November were heavy burdens to which must be added the increase in retirement pensions (+ 28 %) and in cost of materials in general (in the case of coal: + 15 %). The deficit was however reduced to 405 millions pesetas by the application of the law of the 16th December 1954.

Chapter I of the report gives an analysis of the operating figures. The increase in the traffic meant an increase in the train mileage. It should be noted that a greater part of the traction is done now by electric and oil-fired locomotives than in 1955. Some Alco diesel locomotives were put into service. The same chapter also gives details about maintenance works to rolling stock, damages (where the position has considerably improved, especially as regards hot axle boxes), repairs to the stock, the maintenance of the permanent way, purchases (a large proportion of the coal had to be imported from abroad), the rails and sleepers, the staff (a reduction in number of 2 655 out of 121 000) and social activities (160 new houses made available for employees).

The economic and financial results are shown by the amounts of the receipts and expenditures, which are gone into in detail in Chapter II. The amount of expenditure involved did not make it possible to set aside the necessary sums for renewals. A detailed study of the costs based on the method given in the I.R.U. (U.I.C.) folder No. 374 R shows that the deficit applies to both the freight and passenger services. Consequently, the loan facilities given by the decree of the 9th December 1955 were only used with great caution and only after taking full advantage of the Economic Aid Programme due to the agreement made between the Spanish Government and that of the United States on the 23rd September 1953.

Chapter III goes into the multiple works of reconstruction and improvement being carried out on the railway. We may mention amongst these: 17 new modern signal boxes, 448 km (280 miles) of new telephone lines, the extension of centralised traffic control to the traffic on the Seville to Cadiz line. The traction stock has been increased by 10 railcars and various diesel locomotives, as well as 44 electric locomotives; 348 km (217 miles) of tracks have been completely renewed, mainly with heavy rails (54 kg) and many concrete sleepers (RS system) have been laid.

It was possible to complete the electrification of 270 km (168 miles) of lines (Tarragona-Barcelona and Miranda-Bilbao).

The use made of the Economic Aid

Programme is given in Chapter IV, whilst Chapter V is devoted to important forestry works (which supplied 500 000 sleepers) and Chapter VI to road transport.

The report is agreeably illustrated with diagrams and is fully completed by tables of figures and data. It shows both the constant progress made to the installations, rolling stock, and management, and the great financial difficulties due to the very difficult conditions under which the RENFE is working, in particular owing to new labour comitments.

P. SCH.

[(656 .28 (42)]

Lt.-Col. G.R.S. WILSON, C.B.E., Chief Inspecting Officer of Railways, Ministry of Transport and Civil Aviation. — **Report to the Minister of Transport and Civil Aviation upon the Accidents which occurred on the Railways of Great Britain during the year 1956.** — A pamphlet (5 3/4 × 9 1/2 in.) of 68 pages and graphs. — 1957, Her Majesty's Stationery Office, York House, Kingsway, London, W.C.2. and 423 Oxford Street, London W.1. (Price : 3/— net.)

Lt. Col. Wilson's report on the accidents which occurred on the British Railways during 1956 follows the same general plan as the reports for previous years.

The accidents are grouped into three classes :

— train accidents (derailments, collisions) and damage to rolling stock and the permanent way;

— traffic accidents (having a connection with train movements);

— other accidents (having no connection with train movements).

The report begins with a general view of the position in 1956 compared with 1955.

Train accidents increased in number from 1 156 to 1 226 whilst cases of damage to rolling stock and the permanent way decreased from 2 080 to 2 009. The number of victims of train accidents greatly decreased : 608 (18 killed and 590 injured) compared with 975 (59 killed and 916 injured) in 1955. It is pointed out in particular that during the whole of 1956 no railway passenger was killed in a train accident; the 18 persons killed include 3 railway employees' and 15 other persons, 13 of whon were in road vehicles in collisions at level crossings.

Train movement accidents increased from 4 373 (49 killed and 4 324 injured) in 1955 to 4 741 (49 killed and 4 692 injured). As in previous years, most of these accidents were due to the errors of the passengers themselves : getting on or off trains in motion, falls, opening and closing the doors. As regards railway employees, the number of victims was reduced to 2 110 (144 killed and 1 966 injured), which is the lowest figure recorded during the last few years, the average for the years 1951-1955 being 2 368.

Other accidents caused the death of 28 persons, 24 of whom were railway employees, compared with 31 and 17 respectively during 1955.

The report then goes on to analyse the three classes of accident in detail.

As regards the first class, it reports that out of the 1 226 accidents which occurred during 1956, 640, i.e. 52.2 % were due to human error, whereas 124, i.e. 10.1 % were the result of technical failure, most often due to human error. Details are then given of the 8 accidents which during the year were the object of an official enquiry, as well as certain other accidents due to mistakes on the part of employees (running past signals, misunderstanding between traction and signalling employees...)

Mention is made of the measures taken to remedy human errors and improve the installations and stock.

In the chapters devoted to the detailed analysis of accidents in the second and third categories, the author stresses the various causes of accidents to employees.

A special chapter is devoted to accidents at level crossings.

In the final chapter « Review of the year » the author goes into one of the primary causes of accidents. He draws attention to the improvement or worsening of the position compared with previous years, and stresses the measures already in force or under study to prevent accidents : automatic train control, renewal of the stock, improved inspection and maintenance of the rolling stock, renewal of the permanent way, improvement of the permanent way in view of the very fast train services, level crossing gates controlled by track circuits, setting up research committees to prevent accidents at work.

In conclusion, the author is happy to note the decrease in the number of accidents due to technical defects, but he stresses the continual increase over the last few years of the number of accidents due to failure on the part of the staff. He invites the British Transport Commission to devote all its attention to this point in order to effect an improvement in the situation.

R. S.

[**625** .14 (01]

WATTMANN (J.), Reg.-Baumeister und Strassenbahndirektor a.D. — **Längskräfte im Eisenbahngleis** *(Longitudinal forces in the railway track)*. — Second Edition, revised. — One volume, cloth-bound, (6 × 8 1/4 in.), 234 pages, 96 illustrations and tables. — 1957, Darmstadt, Otto Elsner Verlagsgesellschaft, Schöfferstrasse 15. (Price : DM 19.80.)

In 1930, the Otto Elsner publishing house already published a book under the same title by Mr. Wattmann.

That book represented a collection of several articles by the same author which had appeared in the technical press.

The first edition is sold out, and the problem of long rails has, if anything, assumed even greater importance.

With the German Federal Railways, the standard length of rail has increased, step by step, from 30 to 60 and 120 metres, and rails are now being welded continuously over great lengths.

The experience gathered with welded track is the subject of a clear and concise supplement written by Bundesbahnoberrat Dr.-Ing. F. BIRMANN, and appended to the present volume.

In the first part, Mr. Wattmann discusses very thoroughly, with the aid of original graphic representations, the forces which may arise in the rails due to the elimination of joints, temperature fluctuations, friction between foot of rail and tie plates, friction between sleepers and ballast and finally those due to a possible pre-stressing effect.

Special chapters are also devoted to the welding methods and to the problem of buckling in the case of welded track.

These problems, which are particularly well illustrated, are summed up by Dr.-Ing. BIRMANN from a practical point of view and, as already mentioned, on the background of the methods and experience of the Bundesbahn.

This is an excellent book which, as it does not call for the knowledge of higher mathematics, will be useful not only to research engineers but also to staff of all ranks concerned with track welding and track maintenance

J. D.

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[656]

Die Internationale Verkehrsforschung in Deutschland *(Fundamental research into international transport questions in Germany)*. — One brochure (8 1/4 × 11 in.) of 12 pages. — 1957, Hamburg, Hamburgisches Welt-Wirtschafts-Archiv, Poststrasse, 11.

The « Hamburgisches-Welt-Wirtschafts-Archiv » have just published (December 1957) a pamphlet by Messrs. Fr. Henning and W. Nittscher devoted to a review of the present position of fundamental research concerning international transport and the directions in which they think this might usefully be developed. After recalling the value of the work done by the pioneers Emile Sax (1878), R. van der Borght (1894) and others who dealt with the general aspects of transport questions in the economy of peoples and States, and mentioning the studies made since that time, which have been devoted more especially to the tariffs and their effects, paying homage to the studies of C. Pirath, the authors of this pamphlet point out that there is a certain lack at the present time in Germany of fundamental studies.

They point out that the serious confusion in the transport economy to be noticed generally throughout Europe and elsewhere cannot be solved without a study of the various fundamental aspects of these problems. It is not sufficient to examine the aspects that concern different branches of transport (road, railway, canals, airways) and divide them up into studies of costs, economy of methods, etc. but rather to try and make a synthesis between modern theories of the economy of the peoples and the special features of transport in its various forms.

The urgency of the fundamental studies has increased considerably as a result of the imminence of the European Common Market. In this connection, the pamphlet suggests a plan solidly based on research into supernational transport services (transport policies of various countries, ports and hinterlands, problems of transports in economically unified regions, distribution of traffic between the different methods), world maritime transport (currents of transports affecting Germany, underdeveloped countries), the relations between commerce and world transport (alterations in the structure of world commerce world economic alliances) and the contributions of studies having a more practical accent (bases of tarification, finances).

The authors consider that no time should be lost in interesting the national authorities in these points and sketch out practical methods of carrying it out.

P. SCH.

[(656 .222 (73)]

JOSSERAND (Peter). — **Rights of Trains**, 5th Edition. — One volume, cloth bound, (4 1/2 × 7 1/2 in.) of 460 pages, illustrated. — 1957, New York, Simmons-Boardman Publishing Corporation, 30, Church Street. (Price : 6 dollars U.S.A.)

As is known in the United States standard signalling regulations have been adopted by all the railway companies to regulate train movements by mobile signals and by signals worked without interlocking by signalmen (« manual block » signalling). The same standardisation has not yet been achieved in the case of centralised train control (C.T.C.). Peter Josserand, an expert consultant on such matters, has devoted his book « Rights of Trains » to a detailed critical study of

the standard signalling regulations applicable over a great part of the railways and lines.

As the title of the work suggests, apart from areas where the signals are operated either from signal boxes with interlocking or from a distance by a dispatcher (C.T.C.) a train cannot be on or run on a main line unless it is authorised to do so. This authorisation is based on the service timetable (drawn up by the head of the operating department), the class of train, the direction in which it is running (a train running to the North or East has priority over a train running in the opposite direction); there may also be a « train order » given by the dispatcher and conveyed to the driver or guard by a local employee, which modifies the relative priorities of the trains in some particular case (a modification in the normal order of the trains usually involves a fairly long series of « train orders »).

These safety regulations and the idea of the relative priorities of trains have been adopted by all the North American systems (U.S.A., Canada and Mexico), as well as in other countries. They give a common basis of safety not only meeting any momentary failures of the other more perfected signalling systems, but also when there is some accidental diversion of the traffic.

Mr. JOSSERAND's book gives in turn :

— the standard code;
— common operating regulations;
— regulations applied on lines with manual block;
— priority regulations for trains and train movements;
— standard form of train orders.

In the second half of the book, these ideas are taken up again more fully in a long chapter devoted to particular cases (dealt with in the form of questions and answers), in a chapter dealing with the lines worked under the centralised traffic control system. It ends with special information for operators of manual block lines and for dispatchers.

P. SCH.

[**621** .13 (09 (73)]

Hundred years of steam locomotives. Compiled and edited by Walter A. LUCAS. An album (8 3/4 × 11 1/2 in.) of 278 pages with drawings and photographs. — New York, Simmons-Boardman Publishing Corporation, 30 Church Street.

Supplanted by diesel and electric locomotives, — the last steam locomotive put into service in the U.S.A. was built in 1949, — the steam locomotive is on its way out after having reigned supreme on the railways for more than 100 years.

It is, however, one of the machines most representative of the creative spirit of man during the XIXth and early XXth centuries, and for this reason is well deserving of the interest which friends of the railway and model enthusiasts will continue to show in it.

It was above all to satisfy the numerous requests of the latter that the author collected together in the album in question more than two hundred drawings of all the steam locomotives built between 1856 and 1946.

These drawings which have been taken from encyclopedias of the period and which, in addition to the plan in elevation of the locomotive, also give various cross sections, are perfectly to scale, and often accompanied by photographs of the locomotives, so that they will make it possible to build faithful reproductions.

M. Luca's work will also be an invaluable source of documentation regarding the evolution of the constructional technique of the steam locomotive.

R. S.

[313 : 656 (493)]

Schweizerische Verkehrsstatistik *(Swiss Transport Statistics 1956)*. — One volume (8 1/4 × 11 1/2 in.) of 160 pages with 8 diagrams. — 1957, Berne, published by l'*Office Fédéral des Transports*. (Price : 12 Sw. Frs.)

The Swiss Federal Transport Office has just issued the statistics which it publishes every year about transport by the different methods : Federal railways, private railways, special railways (rack, funicular, telpher), tramways, trolleybuses, road, navigation on the lakes, on the Rhine and Airways. The figures, which relate to the year 1956 show the generally happy effects of the prosperous position of the national economy.

A few new tables have been added : entries of motor cars through the frontier zones, ferry-boat traffic on the Swiss lakes and on the Lake of Constance, as well as the ratio of labour costs to the operating costs.

This publication, carefully prepared as always, will certainly be an invaluable source of reference for economic studies, especially after the adoption of the recent Swiss law on transport.

P. Sch.

[625 .28]

Maschinentechnischer Dienst. Band VI der Handbücherei des Eisenbahnwesens. *(Rolling stock service technique)*. — One volume DIN A 5 of 250 pages with numerous tables and illustrations. — 1957, Darmstadt, Carl Röhrig Verlag, Holzhofallee, 33*a*. (Price : DM 9.40.)

This book, which is one of a series devoted to a study of the various departments of the Deutsche Bundesbahn, gives a general picture of the activities of the Rolling Stock and Traction Department and the regulations according to which it works.

The first part deals with the working of the rolling stock. It examines in turn the organisation of the traction units, the organisation of the rolling stock hauled, the braking of the stock, the operation of road vehicles, the maintenance and inspection of the fixed installations in the shops, and the high and low tension electrical installations. A special chapter is also devoted to the designing and construction of the stock; here will be found the principal characteristics of the most up-to-date examples in each category of stock.

The second part describes the organisation of the work in the repair shops. Amongst others, it gives the fundamental factors in determining the work programme of the shops, the research into the most suitable methods of work and the determination of the output of the shops, as well as the rules followed in the preparation, execution and supervision of the work, and the preparation of the accounts.

The third part deals with the question of raw materials and spare parts. In particular, it goes into the regulations concerning the purchase, store keeping and supervision of the consumption of these parts.

To sum up, this book, which will be of interest to railwaymen as well as other technicians, will be invaluable for those who wish to study the working of an undertaking with such vast activities in so many different fields that a railway system is.

R. S.

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1 000 items a minute! Southern's data processing machine gobbles up mountains of railroad paperwork. (3 000 words & figs.)

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Modern Railroads, July, p. 99.
MYERS (E.T.). — **G. N. adopts electronic « brain ».** (3 500 words & figs.)

1957 **656** .223 .2 (73)
Modern Railroads, August, p. 71.
MYERS (E.T.). — **Wabash steps up car reporting.** (2 000 words & figs.)

1957 **656** .25 (73)
Modern Railroads, August, p. 96.
Finger-tip CTC control. (1 000 words & figs.)

1957 **625** .243 (73)
Modern Railroads, August, p. 113.
SPARK (R.). — **Sliding roof car cuts costs.** (600 words & figs.)

Modern Transport. (London.)

1958 **385** .51 (42)
Modern Transport, January 4, p. 5.
Diesel and electric locomotives. Details of manning agreement between B.T.C. and Trade Unions. (1 000 words.)

1958 **621** .335 (54)
Modern Transport, January 11, p. 3.
Electric locomotives in India. (1 000 words & figs.)

1958 **656** .2 (42)
Modern Transport, January 11, p. 11.
RAYMOND (S.E.). — **Selling transport. The practice of British railways.** (2 000 words.)

1958 **625** .4 (485)
Modern Transport, January 18, p. 3.
Stockholm underground. First scheme nears completion. (800 words & figs.)

1958 **656** .222 .6 (42)
Modern Transport, January 18, p. 7.
HOPKINS (C.P.). — **Railway freight traffic operation. In the light of modernisation.** (2 000 words.)

1958 **621** .431 .72 (41) & **625** .285 (41)
Modern Transport, January 25, p. 3.
Versatile Diesel railcars. (2 000 words & figs.)

1958 **656 . 2(42)**
Modern Transport, February 1, p. 3.
The air rail scheme. (1 200 words & figs.)

1958 **656 .212 (42)**
Modern Transport, February 1, p. 7.
Railway freight transit. (1 500 words & figs.)

The Permanent Way Institution Journal. (Tombridge, Kent.)

1957 **625 .14 (01 (42)**
The Permanent Way Institution, December, p. 161.
HANCOCK (R.M.). — **The General problem of track and vehicle reaction and the organisation and running of track testing car No. 139.** (4 000 words.)

1957 **625 .14 (01 (42)**
The Permanent Way Institution, December, p. 166.
COX (E.S.). — **Effect of new forms of motive power on the permanent way. — The mechanical engineer's point of view.** (5 000 words & figs.)

1957 **625 .13 (42)**
The Permanent Way Institution, December, p. 144.
WALDEN (J.G.). — **The construction of the Severn tunnel.** (5 000 words.)

Railway Age. (New York.)

1957 **656 .254 (73)**
Railway Age, December 23, p. 19.
CTC pays off as Maine Central single tracks-slashes costs. (1 000 words & figs.)

1957 **625 .244 (73)**
Railway Age, December 23, p. 26.
What's new about this car? (600 words & figs.)

1958 **625 .174 (73)**
Railway Age, January 6, p. 18.
Mobilized cleanups click with better planning. — Practical goals. (2 400 words & figs.)

1958 **625 .143 (73)**
Railway Age, January 6, p. 21.
Rail treatment pays big returns. (1 300 words & figs.)

1958 **656 .254 (73)**
Railway Age, January 13, p. 23.
Capacity for 15 more trains fast. (2 200 words & figs.)

Railway Engineering. (Cape Town.)

1958 **625 .28**
Railway Engineering, January, p. 20.
Sixty years of development in locomotives, passenger coaches and goods wagons. (1 200 words & figs.)

The Railway Gazette. (London.)

1957 **656 .254 (42)**
The Railway Gazette, December 13, p. 679.
St. Pancras terminus re-signalling, L.M.R. (1 400 words & figs.)

1957 **656 .254 (42)**
The Railway Gazette, December 13, p. 690.
Improved automatic junction working, L.T.E. Northern Line. (300 words & figs.)

1957 **621 .335 (54)**
The Railway Gazette, December 20, p. 712.
Locomotives for Indian 3 000 V electrification. (1 400 words & figs.)

1957 **621 .335 (492 + 493)**
The Railway Gazette, December 20, p. 715.
Amsterdam-Brussels dual-voltage trains. (200 words & figs.)

1957 **656 .254 (42)**
The Railway Gazette, December 27, p. 739.
New signalbox at Cannon Street, Southern Region. (1 200 words & figs.)

1957 **656 .212 (42)**
The Railway Gazette, December 27, p. 742.
Mechanised marshalling yard at Thornton, Fife. (3 000 words & figs.)

1958 **625 .245 (6)**
The Railway Gazette, January 3, p. 11.
Special-duty wagons for Kariba Dam project. (500 words & figs.)

1958 **656 .254 (42)**
The Railway Gazette, January 3, p. 12.
Standardisation of signal aspects on London Transport. (2 000 words & figs.)

Diesel Railway Traction. A Railway Gazette Publication (London.)

1957 **621 .431 .72 (42)**
Diesel Railway Traction, December, p. 448.
Two prototype shunting locomotives. (400 words & figs.)

1957 **621 .431 .72 (42)**
Diesel Railway Traction, December, p. 449.
The Fell locomotive. Experience with the original design and proposals for future construction. (1 800 words & figs.)

1957 **621 .431 .72 (42)**
Diesel Railway Traction, December, p. 453.
British flat engine for railcars. (900 words & figs.)

1957 **625 .285**
Diesel Railway Traction, December, p. 439.
Italian TEE train sets. (3 400 words & figs.)

1957 **621** .431 .72
Diesel Railway Traction, December, p. 476.
Graphic determination of train performance. (1 800 words & figs.)

1958 **621** .431 .72 (47)
Diesel Railway Traction, January, p. 3.
Soviet Type TE 3 Diesel-electric locomotive. (2 400 words & figs.)

1958 **621** .431 .72 (497 .1)
Diesel Railway Traction, January, p. 13.
2 200 HP locomotives in Jugoslavia. (3 500 words & figs.)

1958 **621** .431 .72 (42)
Diesel Railway Traction, January, p. 21.
Swindon-built diesel-hydraulic locomotives. (2 500 words & figs.)

1958 **621** .431 .72
Diesel Railway Traction, January, p. 30.
The O.R.E. locomotive. (900 words & figs.)

Railway Track and Structures. (Chicago.)

1958 **624** .63 (73)
Railway Track and Structures, January, p. 21.
Two Santa Fe bridges have... prestressed concrete girders. (1 600 words & figs.)

1958 **625** .143 .4 (73)
Railway Track and Structures, January, p. 24.
« **Glued** » **rail...** (1 200 words & figs.)

1958 **625** ,143. 5 (73)
Railway Track and Structures, February. p. 23.
Rail anchors... attain new stature as a cost-saving device. (4 600 words & figs.)

Railway Signaling and Communications. (New York.)

1957 **656** .254 (73)
Railway Signaling and Communications, October, p. 29.
Bar takes up second track... and installs CTC. (1 400 words & figs.)

1957 **656** .258 (73)
Railway Signaling and Communications, October, p. 32.
Lehigh valley combines interlockings. (1 000 words & figs.)

1957 **656** .212 (73)
Railway Signaling and Communications, October, p. 34.
Retarders save time at car dumper. (900 words & figs.)

V.M.F. Review. (Brussels.)

1958 **625** .28 (492 + 494)
V.M.F. Review, January, No. 6, p. 267.
OUDENDAL (F.). — **The motor coaches of the Trans Europ Express train sets.** (4 500 words & figs.)

In Spanish.

Ferrocarriles y Tranvias. (Madrid.)

1958 **385**
Ferrocarriles y Tranvias, nº 273, p. 122.
NAVARRO GIL (L.). — **Problemas ferroviarios.** *(Continuación.)* (2 500 palabras & fig.)

1958 **625** .212 : **625** .42 (44)
Ferrocarriles y Tranvias, nº 273, p. 126.
BOUILLOUD (P.). — Los **trenes con neumáticos** del metropolitano de Paris. (1 200 palabras & fig.)

In Italian.

Alluminio. (Milano.)

1958 **669**
Alluminio, nº 1, p. 13.
FLUSIN (F.). — **Oxydation anodique.** Observations et perfectionnements récents. (2 000 parole & fig.)

Giornale del Genio Civile. (Roma.)

1957 **624**
Giornale del Genio Civile, dicembre, p. 1099.
SORGENTE (V.). — Il tema di **calcolo a rottura.** Risultati sperimentali relativi ad una struttura da ponte a volta irrigidita. (2 000 parole & fig.)

1957 **624** .2
Giornale del Genio Civile, dicembre, p. 1110.
PASANISI (G.). — Il **calcolo della trave a ginocchio** con il metodo delle deformazioni. Le **formule risolutive per la trave incastrata.** (2 000 parole & fig.)

Ingegneria Ferroviaria. (Roma.)

1957 **625** .13
Ingegneria Ferroviaria, dicembre, p. 993.
ZIGNOLI (V.). — I problemi dei **trafori alpini ferroviari e stradali.** (4 500 parole & fig.)

1957 **624**
Ingegneria Ferroviaria, dicembre, p. 999.
di BERARDINO (V.). — Una notevole semplificazione del **metodo di Cross** : il calcolo di particolari strutture a molte iperstatiche eseguito con sole due « passate ». (1 500 parole & tavole.)

1957 **656** .223
Ingegneria Ferroviaria, dicembre, p. 1005.
RUSSO FRATTASI (A.). — Sulla programmazione « ottima » della **distribuzione dei carri vuoti** dai centri di concentramento ai centri utilizzatori. (1 500 parole & tavole.)

1957 **656** .1 (4)
Ingegneria Ferroviaria, dicembre, p. 1014.
BONACINA (E.). — Gli **autotrasporti sostitutivi** all' estero. (3 000 parole.)

Trasporti Pubblici. (Roma.)

1957 **656** .2 (4)
Trasporti Pubblici, novembre, p. 1465.
La **situazione dei trasporti ferroviari europei** in una relazione del Direttore Generale delle Ferrovie dello Stato Ing. Rissone. (2 000 parole.)

In Netherlands.

De Ingenieur. (Den Haag.)

1958 **625** .2
De Ingenieur, nr 5, 31 januari, p. W. 9.
VAN ELDIK THIEME (H.C.A.). — Enkele aspecten van het **onderzoek van rail- en wegvoertuigen.** (3 000 woorden & fig.)

1958 **621** .3
De Ingenieur, nr 6, 7 februari, p. E. 21.
WETZGER (J.). — **Wirkungsweise und Anwendung des Magnetverstärkers.** (5 000 woorden & fig.)

1958 **621** .3
De Ingenieur, nr 6, 7 februari, p. E. 26.
BORG (L.F.). — **Application of Transductors for automatic control.** (2 500 woorden & fig.)

1958 **625** .285 (43)
De Ingenieur, nr 7, 14 februari, p. V. 5.
Twee-assige railbussen in de Duitsche Bondesrepubliek. (1 000 woorden & fig.)

1958 **721** .1 (48)
De Ingenieur, nr 8, 21 februari, p. B. 33.
VAN DER VEEN (C.). — **De grondmechanica in Scandinavië.** (4 000 woorden & fig.

Spoor- en Tramwegen. (Den Haag.)

1958 **656** (4)
Spoor- en Tramwegen, nr 3, 30 januari, p. 146.
LANDSKROON (E.P.A.). — De **coördinatie van het Europese vervoer.** I. (1 500 woorden.)

1958 **621** .436
Spoor- en Tramwegen, 13 februari, p. 54.
LAMME (N.). — **Controle van dieselmotoren** door middel van systematische olie-analyse. (1 800 woorden & fig.)

1958 **656** (4)
Spoor- en Tramwegen, 13 februari, p. 60.
LANDSKROON (F.P.A.). — De **coördinatie van het Europese vervoer.** II. (2 500 woorden.)

In Portuguese.

Gazeta dos Caminhos de Ferro. (Lisboa.)

1958 **385** (09 (469)
Gazeta dos Caminhos de Ferro, nº 1683, 1 de Fevereiro, p. 75.
MANITTO TORRES (C.). — A **evolucão das linhas portuguesas** e o seu significado ferroviário. *(Continua.)* (2 000 palavras.)

1958 **385** .1
Gazeta dos Caminhos de Ferro, nº 1683, 1 de Fevereiro, p. 79.
de BRITO LEAL (C.). — O problema da **situacão financeira** dos Caminhos de Ferro. *(Continua.)* (2 000 palavras.)

Técnica. (Lisboa.)

1957 **621** .3
Técnica, nº 277, dezembro, p. 171.
REBELO SIMÕES (F.E.). — Técnica de impulsos. *(Continua.)* (5 000 palavras & fig.)

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